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# INDEX

TO THE

## EXECUTIVE DOCUMENTS

OF THE

### HOUSE OF REPRESENTATIVES

FOR THE

SECOND SESSION OF THE FORTY-FOURTH CONGRESS.

1876—'77.

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#### IN THIRTEEN VOLUMES.

- Volume 1...No. 1, part 1. Foreign Relations.  
Volume 2...No. 1, part 2, War: parts 1, 3, 4, and 2, volumes 1, 2, and 3.  
Volume 3...No. 1, parts 3 and 4, (Postmaster and Navy.)  
Volume 4...No. 1, part 5, Interior: parts 1 and 2.  
Volume 5...No. 1, parts 6, 7, 8, and Nos. 7 to 20 inclusive.  
Volume 6...No. 2.  
Volume 7...Nos. 3 and 4.  
Volume 8...Nos. 5, 6, and 36.  
Volume 9...Nos. 21 to 44 inclusive, except 36, 40, and 43.  
Volume 10...No. 40, parts 1 and 2.  
Volume 11...No. 43, (Mail Contracts.)  
Volume 12...No. 45, Commercial Relations.  
Volume 13...No. 46, parts 1 and 2, Commerce and Navigation.
- 

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1877.



INDEX  
TO  
THE EXECUTIVE DOCUMENTS  
OF THE  
HOUSE OF REPRESENTATIVES OF THE UNITED STATES  
FOR THE  
SECOND SESSION OF THE FORTY-FOURTH CONGRESS, 1876-77.

Subject.	Vol.	Part.	No.
A.			
Argentine Republic, congratulations from the.....	9	.....	33
Army, use of the, message from the President of the United States in regard to the, in certain of the Southern States .....	9	.....	30
Attorney-General, annual report of the.....	5	.....	20
B.			
Baird, Professor, letter from, relative to the Government collection at the Centennial Exhibition .....	5	8	1
C.			
Cavalry force, increase of, on the Texas frontier.....	9	.....	33
Centennial Exhibition, Government collection at .....	5	8	1
report of board of United States Executive Departments at the.....	10	.....	40
Claims, list of 449, allowed by accounting-officers of the Treasury Department .....	9	.....	35
Commerce and Navigation, report of the Chief of Bureau of Statistics on the.....	13	.....	46
Commercial relations, report upon the, of the United States with foreign countries for the year 1876.....	12	.....	45
Commissioner of Internal Revenue, report of.....	7	.....	4
Commissioner of Patents, report of.....	8	.....	36
Comptroller of the Currency, annual report of the.....	7	.....	3
Contingent expenses, letter from the Postmaster-General, transmitting statement of the expenditure of the contingent-fund of his Department. ....	5	.....	13
letter from the Secretary of the Navy, transmitting statement of the contingent-fund of his Department .....	5	.....	11
letter from the Secretary of State, transmitting statement of the disbursement of the contingent-fund of his Department, for the year ending June 30, 1876.....	5	.....	9
letter from the Secretary of the Treasury, transmitting the statement of the contingent-fund of his Department for the year ending June 30, 1876 .....	9	.....	42
Currency, annual report of the Comptroller of.....	7	.....	3
Customs-officers, fees received by .....	9	.....	29

Subject.	Vol.	Part.	No.
<b>D.</b>			
District of Columbia, report of the Commissioners of the .....	5	6	1
administration of the provisional government .....	9	.....	26
report of the Board of Health of the.....	5	7	1
<b>E.</b>			
Eads, James B., settlement in favor of .....	9	1	28
issue of United States bonds to.....	9	2	28
Employés in the War Department, list of.....	9	.....	27
Engineers, Chief of, annual report of the, transmitted by the Secretary .....	2	2	1
of War in his report, vol. 2, part 1.....	5	.....	16
Estimates for Soldiers' and Sailors' Orphans' Home .....	5	.....	11
Expenses of the Navy Department, letter from the Secretary of the .....	5	.....	7
Navy, transmitting statement of the .....	5	.....	15
Expenses of War Department, letter from the Secretary of War, trans- .....	5	.....	15
mitting list of.....	5	.....	15
Extradition treaty between the United States and Great Britain, mes- .....	5	.....	15
sage of the President relative to .....	5	.....	15
<b>F.</b>			
Foreign relations, message of the President of the United States, .....	1	1	1
transmitting papers relating to the, of the United States.....	1	1	1
<b>H.</b>			
Hallett's Point, destruction of the reef at .....	9	.....	24
Henry, Professor, letter from, relative to the Government collection at .....	5	8	1
the Centennial Exhibition.....	5	8	1
<b>I.</b>			
Indians, letter from the Secretary of the Interior, transmitting tabular .....	8	.....	6
statements of the disbursements made from the appropri- .....	5	.....	10
ations for the Indian Department for the fiscal year ending .....	8	.....	6
June 30, 1876 .....	4	5	1
message from the President of the United States, transmitting .....	5	.....	16
letter from the Secretary of the Interior, relative to the re- .....	5	.....	10
moval of the Sioux .....	7	.....	4
Interior, Secretary of the, transmitting tabular statements of disburse- .....	9	.....	40
ments made from the appropriations for .....	8	.....	6
the Indian Department, for the fiscal year .....	4	5	1
ending June 30, 1876 .....	5	.....	16
annual report of the .....	5	.....	10
letter from the, transmitting estimates for .....	5	.....	10
the Soldiers' and Sailors' Orphans' Home .....	5	.....	10
letter from the, relative to the removal of .....	5	.....	10
the Sioux Indians.....	7	.....	4
Internal Revenue, report of the Commissioner of .....	9	.....	40
International Exhibition, report of board of United States Executive .....	9	.....	40
Departments at the .....	9	.....	40
<b>M.</b>			
Mails, letter from Postmaster-General, relative to offers for carrying .....	11	.....	43
the.....	9	.....	25
McKinstry, Major Justus, letter from the Secretary of War in regard .....	9	.....	34
to the case.....	9	.....	34
Mill Creek, Ohio, harbor of refuge at .....	5	.....	12
Mississippi River, report of the engineer on the condition of the works .....	9	.....	41
at South Pass of the .....	9	.....	41
navigation of the .....	9	.....	41

Subject.	Vol.	Part.	No.
<b>N.</b>			
<b>Navy, Secretary of the, annual report of the</b> .....	3	4	1
letter from the, transmitting the report of board of officers relative to dispensation of navy-yards .....	5	.....	8
letter from the, transmitting statement of expenditure of the contingent fund of the Navy Department .....	5	.....	11
<b>Navy-yards, letter from the Secretary of the Navy transmitting re- port of board of officers relative to the sale of</b> .....	5	.....	8
<b>O.</b>			
<b>Ohio, letter from the Secretary of War, transmitting a report on the harbor of refuge at Mill Creek, in</b> .....	9	.....	34
<b>Ordinance, Chief of, annual report of the, letter from the Secretary of War (vol. 3) inclosing the</b> .....	2	2	1
<b>P.</b>			
<b>Postmaster-General, annual report of the</b> .....	3	3	1
letter from the, transmitting a statement of the expenditure of the contingent fund of his De- partment for the year ending June 30, 1876....	5	.....	13
letter from the, relative to offers for carrying the mails .....	11	.....	43
<b>Pretoria, South Africa, republic of, congratulations from the</b> .....	9	.....	32
<b>President of the United States, message from the, transmitting annual message and accompanying docu- ments, 2d session 44th Congress</b> .....	1	1	1
message from the, transmitting letter from the Secretary of the Interior relative to removal of Sioux Indians .....	5	.....	10
message from the, transmitting docu- ments relative to the execution of the extradition article of the treaty of 1842 between the United States and Great Britain .....	5	.....	15
message from the, transmitting state- ment of the Secretary of War con- cerning appropriations for the im- provement of rivers and harbors....	9	.....	23
message from the, transmitting report of the Commissioners and board of audit of the District of Columbia....	9	.....	26
message from the, transmitting state- ment relative to the use of the Army in certain of the Southern States ...	9	.....	30
message from the, relative to the im- prisonment of John Jay Smith and Dr. Samuel Huggins .....	9	.....	31
message from the, assigning reasons for withholding his approval of the bill (H. R. 3367) to remove the charge of desertion from the military record of Alfred Rowland .....	9	.....	39
message from the, relative to the in- crease of the cavalry force upon the Texas frontier .....	9	.....	33
message from the, regarding the re- sumption of specie payments .....	9	.....	37
message from the, transmitting report of the Secretary of State concern- ing the agency of A. B. Steinberger.	9	.....	44

Subject.	Vol.	Part.	No.
<b>R.</b>			
Railroads, report of the survey of the Union and Central Pacific .....	9	.....	38
Rivers and harbors, appropriations for .....	9	.....	23
River, Mississippi, report of the Chief Engineer on the condition of the works at the South Pass of the .....	5	.....	12
Rouland, Alfred, message from the President relative to the case of...	9	.....	39
<b>S.</b>			
Seamen, registered, receiving citizenship .....	5	.....	17
Smith, John Jay, and Dr. Samuel Huggins, imprisonment of .....	9	.....	31
Soldiers' and Sailors' Orphans' Home, estimates for .....	5	.....	16
Specie payments, resumption of .....	9	.....	37
State, Secretary of, transmits statement of the disbursements of the contingent fund of his Department for the year ending June 30, 1876. ....	5	.....	9
transmits statement of registered seamen receiv- ing citizenship .....	5	.....	17
transmits statement of persons employed in that Department .....	9	.....	21
Statistics, report of the Chief of Bureau of .....	13	.....	46
Steinberger, A. B., message from the President relative to .....	9	.....	44
<b>T.</b>			
Texas, accounts of the State of .....	5	.....	14
Treasury, Secretary of the, annual report of the .....	6	.....	2
letter from the, transmitting estimates of appropriations for fiscal year ending June 30, 1878 .....	8	.....	5
letter from the, transmitting statement of balance required to be appropriated for the fiscal year ending June 30, 1875, and prior years .....	5	.....	18
letter from the, transmitting estimate of appropriations required by the various departments for the year ending June 30, 1877, and prior years .....	5	.....	19
letter from the, transmitting documents in reference to the issue of United States bonds to James B. Eads .....	9	2	28
letter from the, transmitting a statement of fees received by customs-officers dur- ing the year ending June 30, 1876. ....	9	.....	29
letter from the, transmitting report of the contingent expenses of the Treasury De- partment for the fiscal year ending June 30, 1876 .....	9	.....	42
Treasury Department, list of 449 claims allowed by the accounting- officers of the .....	9	.....	35
<b>W.</b>			
War, Secretary of, transmits annual report of the Chief of Engineers, (vol. 2, part 1) .....	2	2	1
transmits annual report of the Chief of Engineers, (vol. 2, part 2) .....	2	2	1
transmits annual report of the Chief of Ordnance, (vol. 3) .....	2	2	1
transmits report of the contingent expenses of the War Department .....	5	.....	7
transmits report of the engineer on the condition of the works at the South Pass of the Mississippi River letter from the, concerning accounts of the State of Texas .....	5	.....	12
letter from the, in answer to House resolution call- ing for the number of enlisted men in the United States Army, and their present location .....	5	.....	14
letter from the, in answer to House resolution call- ing for the number of enlisted men in the United States Army, and their present location .....	9	.....	22



Subject.	Vol.	Part.	No.
<b>War, Secretary of,</b> letter from the, transmitting the report of Lieut.-Col. John Newton upon the destruction of the reef at Hallett's Point. ....	9	.....	24
letter from the, relating to the case of Major Justus McKinstry. ....	9	.....	25
letter from the, transmitting list of employés in the War Department. ....	9	.....	27
letter from the, transmitting papers and documents concerning the improvement of the South Pass of the Mississippi River. ....	9	1	28
letter from the, transmitting a report on the harbor of refuge at Mill Creek, Ohio River. ....	9	.....	34
letter from the, transmitting a report on the survey of the Union and Central Pacific Railways. ....	9	.....	38



REPORT  
OF THE  
POSTMASTER-GENERAL  
OF THE  
UNITED STATES;  
BEING PART OF  
THE MESSAGE AND DOCUMENTS  
COMMUNICATED TO THE  
TWO HOUSES OF CONGRESS  
AT THE  
BEGINNING OF THE SECOND SESSION OF THE FORTY-FOURTH CONGRESS.



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1876.



# CONTENTS.

## FINANCES.

	Page.
Financial condition .....	iii
Estimates for 1878 .....	iv
Special appropriations .....	iv
Deficiency appropriations .....	v
Net balance on deficiency appropriations .....	v
Issues of postage-stamps, stamped envelopes, and postal cards .....	v
Increase in issues .....	v
Lost postage-stamps .....	v
Dead letters .....	vi

## CONTRACTS.

Transportation statistics .....	vi
Re-adjustment of pay on railroad-routes .....	vii
Fines and deductions .....	vii
Mail bags, locks, and keys .....	vii
Mail depredations .....	viii
Railway post-office lines .....	ix
Post-route maps .....	ix

## FOREIGN MAILS.

Postal Union treaty .....	ix
Weights of mails sent to Europe .....	x
Cost of sea-transportation .....	x
Atlantic sea-postages on foreign closed mails .....	xi
Total cost of ocean mail-service .....	xi
Expiration of mail-subsidy to China line .....	xi
Increased territory of General Postal Union .....	xii
Modifications of treaty and regulations proposed through the international bureau .....	xii
Postal convention with Queensland .....	xiv
Additional postal agreement with Japan .....	xiv
Postal convention with Bermuda .....	xiv
Additional agreement with Newfoundland .....	xiv
Pending negotiations for new postal arrangements .....	xiv

## APPOINTMENTS.

Number of post-offices .....	xv
Number of appointments .....	xv
Cases acted on .....	xv
Special, route, and local agents .....	xv
Number of officers, agents, and employes in the postal service .....	xv
Free delivery .....	xvi
Aggregate results of free-delivery service .....	xvii
Salaries of letter-carriers .....	xvii
Number of money-order offices .....	xvii
Issues and payments .....	xvii
Duplicate orders .....	xviii
Receipts and expenditures .....	xviii
Deposit of surplus funds .....	xx
Orders improperly paid .....	xx
Exchange of postal money-orders with foreign countries .....	xxi
General financial results .....	xxii

## MISCELLANEOUS.

Salaries of postmasters .....	xxiii
Straw-bids .....	xxvi
Reduction of pay to railroads .....	xxvii
Withdrawal of fast-mail trains .....	xxviii
Interference with postal officers and employes .....	xxix
Transit-charges on British closed mails .....	xxx
Postal deficiencies .....	xxx

## CONTENTS OF APPENDIX.

	Page.
No. 1. Estimates for expenditures for the fiscal year ending June 30, 1878 .....	1
No. 2. Estimate of indebtedness of the Post-Office Department for the fiscal year ended June 30, 1876, (not yet adjusted) .....	23
No. 3. Statement exhibiting the receipts and expenditures under appropriate heads, by quarters, for the fiscal year ended June 30, 1876, compared with fiscal years ended June 30, 1875, and June 30, 1874.....	24
No. 4. Receipts and disbursements at Treasury depositories during the fiscal year ended June 30, 1876.....	26
No. 5. Receipts and disbursements at depository post-offices on account of the fiscal year ended June 30, 1876.....	28
No. 6. Postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the fiscal year ended June 30, 1876.....	31
No. 7. Postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the fiscal year ended June 30, 1876.....	35
No. 8. Statement of official stamps and stamped envelopes furnished each of the Executive Departments during the fiscal year ended June 30, 1876.....	37
No. 9. Statement showing the increase in the issue of postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards, including the issues for official use, for the year ended June 30, 1876, over those of the preceding year.....	38
No. 10. Statement showing the number of dead letters received and disposed of during the fiscal year ended June 30, 1876.....	39
No. 11. Statement showing the classification and disposition of letters containing valuable inclosures during the fiscal year ended June 30, 1876.....	40
No. 12. Statement showing number, contents, and disposition of registered letters received during the fiscal year ended June 30, 1876.....	40
No. 13. Number of registered letters transmitted through the mails, from each State and Territory in the United States, during the fiscal year ended June 30, 1876.....	41
Letter of Second Assistant Postmaster-General referring to tables.....	43
A. Table of mail-service for the year ended June 30, 1876, as exhibited by the state of the arrangements at the close of the year.....	44
B. Railroad-service as in operation on the 30th of June, 1876.....	46
C. Steamboat-service as in operation on the 30th of June, 1876.....	53
D. Table showing the increase and decrease in mail-transportation, and cost, during the year ended June 30, 1876.....	88
E. Table showing the weight of the mails, the speed with which they are conveyed, the accommodations for mails and agents, the trips per week, and the rates of pay per mile per annum on railroad-routes in States in which the contract-term expired June 30, 1876, and also in other States and Territories, the returns having been obtained with a view to the re-adjustment of the pay in accordance with the act of March 3, 1873; and used also in accordance with the act of July 12, 1876, in the case of re-adjustments taking effect on and after July 1, 1876.....	90
Index to Table E.....	118
F. Table showing the re-adjustment of the rates of pay per mile on railroad-routes in States in which the contract-term expired June 30, 1876, and in other States and Territories, and on certain new routes the adjustment of the rates, based upon returns of the weight of the mails, the speed with which they are conveyed, the accommodations for mails and agents, and the number of trips per week, in accordance with the act of March 3, 1873, and with the act of July 12, 1876, in the case of re-adjustments taking effect on and after July 1, 1876.....	122
Index to Table F.....	154
G. Statement of the number, description, and prices of mail-bags, mail-bag catchers, mail locks and keys purchased, and of the expense incurred on account thereof, during the fiscal year ended June 30, 1876.....	157
H. Railway post-office lines in the United States June 30, 1876, showing the increase in the service since June 30, 1875.....	158
Report relative to operations of railway mail-service.....	160
Statement of the weight of mails dispatched to postal-union countries during the year.....	166
Arrangement concerning the entrance into the General Postal Union of British India and the French colonies.....	168
Postal convention between the United States of America and the colonial government of Queensland.....	172
Additional agreement between the United States of America and the empire of Japan, modifying the provisions of the postal convention of the 6th of August, 1873, and also of the agreement of April 26, 1875, between the two countries.....	175
Postal convention between the United States of America and Bermuda.....	176

# CONTENTS.

III

Page.

Additional articles of agreement between the Post-Office Departments of the United States of America and Newfoundland .....	180
Special arrangement between the General Post-Offices of the United States and the United Kingdom, fixing rates of territorial transit-charges on British closed mails conveyed across the American continent between Boston or New York and San Francisco .....	180
Table showing the increase and decrease of post-offices in the several States and Territories; also the number of post-offices at which appointments are made by the President and by the Postmaster-General, for the year ended June 30, 1876.....	182
Operations of the appointment-office for the year ended June 30, 1876 .....	183
Statement of the operations of the free-delivery system for the year ended June 30, 1876.....	184
Report of the Auditor of the Treasury for the Post-Office Department.....	191





# REPORT OF THE POSTMASTER-GENERAL.

POST-OFFICE DEPARTMENT,  
*Washington, D. C., November 27, 1876.*

SIR: The expenditures of this Department during the fiscal year ended June 30, 1876, were..... \$33,263,487 58

The revenues were as follows :

Ordinary receipts . . . . .	\$28,453,426 66
Receipts from money-order business..	190,770 84
Amount received from the general Treasury as sums appropriated to steamship-lines . . . . .	537,500 00
	29,181,697 50

Excess of expenditures over receipts..... 4,081,790 08

Included in the above statement of expenditures is the sum of \$467,301.42 paid on liabilities incurred in previous fiscal years and not properly chargeable to the expenditures of the last fiscal year. Deducting this sum from the aggregate amount, the actual expenditures for the year were \$32,796,186.16.

The expenditures and receipts of the Department, therefore, on account of and appertaining to the business of the last fiscal year (excluding expenditures on account of previous years) are as follows, to wit :

Expenditures .....	\$32,796,186 16
Receipts, ordinary and from money-order business .....	28,644,197 50

Leaving an excess of expenditures over and above departmental receipts of .....	4,151,988 66
---	--------------

The expenditures during the fiscal year were \$523,196.21 more than those of the preceding year, and \$3,700,546.42 less than the estimates therefor.

The ordinary receipts for the year were \$1,782,208.16 (or 6.26 per cent.) more than those of the preceding year, and \$33,541.50 (or 0.11 per cent.) more than the estimates therefor.

The expenditures and receipts by fiscal quarters, and the increase or decrease therein as compared with the corresponding quarters of 1873-'74 and 1874-'75, are shown by Table 4 which accompanies the report of the Third Assistant Postmaster-General.

There was drawn from the Treasury during the fiscal year on appropriations—

For steamship service to Japan and China.....	\$500,000 00
For steamship service to Brazil.....	37,500 00
To supply deficiencies in the revenues for the year ended June 30, 1876	4,000,000 00
To meet deficiencies of previous fiscal years.....	551,029 23
In pursuance of act of Congress (private, No. 12) of June 23, 1876.....	53 80
<b>Total.....</b>	<b>5,088,583 03</b>

The estimated expenditures for the fiscal year ending June 30, 1878, are. \$36,723,432 43

The ordinary revenues are estimated at 7 per cent. over

the past fiscal year, making..... \$30,445,165 00

Estimated revenue from money-order business..... 200,000 00

**Total estimated revenue for the fiscal year ending**

June 30, 1878..... 30,645,165 00

Estimated excess of expenditures to be appropriated out of the general

Treasury as a deficiency ..... 6,078,267 43

Of the appropriations for deficiencies there were unexpended on June 30, 1875, the following amounts:

For fiscal year ended June 30, 1871.....	\$14,146 38
For fiscal year ended June 30, 1872.....	3,393 98
For fiscal year ended June 30, 1873.....	680,830 11
For fiscal year ended June 30, 1874.....	1,006,574 51
For fiscal year ended June 30, 1875.....	1,097,842 00

2,802,786 98

**Amount appropriated for fiscal year of 1875-'76.....** 6,852,705 00

**Total.....** 9,655,491 98

During the past fiscal year the following amounts were drawn on account of payments for previous fiscal years, viz:

For fiscal year of 1870-'71.....	\$14,146 38
For fiscal year of 1871-'72.....	3,393 98
For fiscal year of 1874-'75.....	533,488 87
For fiscal year of 1875-'76.....	4,000,000 00

**A total of.....** 4,551,029 23

**Amount of deficiency appropriations undrawn and available for payments of indebtedness to June 30, 1876.....** \$5,104,462 75

Against the above sum there are chargeable the following unsettled accounts, estimated:

Balance due foreign countries.....	\$12,000 00
Mail-service under contract, or recognized, not yet reported for payment.....	989,069 50
Mail-service unrecognized.....	353,024 85
<b>Total.....</b>	<b>1,354,094 35</b>

**Leaving after settlement of all liabilities to June 30, 1876, a net balance on deficiency appropriations of.....** 3,750,368 40

## POSTAGE-STAMPS, STAMPED ENVELOPES, AND POSTAL CARDS ISSUED.

The number of ordinary postage-stamps issued during the past fiscal

year was 698,799,090, valued at.....	\$18, 773, 454 00
Newspaper and periodical stamps, 1,290,347 .....	945, 254 75
Stamped envelopes, plain, 82,467,000 .....	2, 280, 318 74
Stamped envelopes, request, 64,554,500 .....	2, 079, 578 30
Newspaper-wrappers, 18,498,750 .....	273, 723 50
Postal cards, 150,815,000 .....	1, 508, 150 00
Official postage-stamps, 17,682,665 .....	663, 831 50
Official stamped envelopes and wrappers, 15,690,155 .....	429, 110 93

Aggregating 1,049,797,507 ..... 26, 953, 421 72

The following table shows the increase in stamps of all kinds, stamped envelopes, newspaper-wrappers, and postal cards over the previous year :

Description.	Fiscal year ended June 30, 1876.	Fiscal year ended June 30, 1875.	Increase.	
			Value.	Per cent.
Ordinary postage-stamps.....	\$18, 773, 454 00	\$18, 271, 479 00	\$501, 975 00	2. 74
Stamped envelopes, plain .....	2, 280, 318 74	2, 046, 111 35	234, 207 39	11. 44
Stamped envelopes, request .....	2, 079, 578 30	1, 791, 686 25	287, 892 05	10. 06
Newspaper-wrappers .....	273, 723 50	286, 679 74	*12, 956 24	*4. 50
Newspaper and periodical stamps....	945, 254 75	815, 902 47	129, 352 28	15. 85
Postal cards .....	1, 508, 150 00	1, 076, 160 00	431, 990 00	40. 14
Total, after deducting for decrease in item of newspaper-wrappers .....			1, 572, 460 48	6. 47
Official stamps, and stamped envelopes and wrappers .....	1, 092, 942 43	1, 189, 493 43		
Deduct for decrease in last item .....			96, 550 00	8. 11
Aggregate .....	26, 953, 421 72	25, 477, 511 24	1, 475, 910 48	5. 79

\* Decrease.

During the past fiscal year there has been a loss of seven packages of stamps, stamped envelopes, and postal cards, of the aggregate value of only \$147.45.

The amount of postage collected during the year, under the act of Congress approved June 23, 1874, (which took effect January 1, 1875,) on newspaper and periodical publications mailed to regular subscribers or news agencies from known offices of publication, commonly known as second-class matter, was \$1,014,154.27, derived from 39,444,599 pounds of matter at 2 cents per pound, and 7,508,743 pounds at 3 cents per pound. The amount collected during the six months ending June 30, 1875, was \$486,443.49. The increase is therefore at the rate of \$41,267.29, or 4.24 per cent. per annum.

The operations of the Dead-Letter Office are fully stated in the report of the Third Assistant Postmaster-General, and tables Nos. 10, 11, and 12, appended thereto. This business may be briefly summarized as follows: Total number of letters received during the year, 3,542,494, an average of 11,540 for each working day, and classified thus: ordinary mail letters, 2,355,194; local or drop, 445,000; of domestic origin returned from foreign countries, 108,632; foreign origin, 195,800; returned to post-offices by proprietors of hotels, 45,136; held for postage, 307,559;

misdirected, 69,797; ship, 2,884; without address, 6,945; and 5,547 registered letters. They are further classified according to their contents as follows: 25,740 contained \$41,447.17 in money; 12,043 contained commercial paper to the value of \$1,754,648.31; 846 contained deeds, mortgages, leases, railroad and other passage tickets, pension certificates, and bank-books; 37,054 contained postage-stamps; 31,318 contained photographs; 20,367 contained jewelry, clothing, books, chromos, music, merchandise, &c.; 25,788 contained receipts, bills of lading, affidavits, abstracts of title, paid notes, and canceled obligations of all sorts.

The whole number of registered letters received, including 201 from last fiscal year, was 5,748, of which 5,422 were delivered. The amount of money taken from letters which could not be restored to the owners was \$6,052.53. Amount realized from sale of Dead-Letter Office property at auction, \$2,853.17.

#### CONTRACTS.

There were in the service of the Department on the 30th of June, 1876, 6,126 contractors for the transportation of the mails on public routes.

There were at the close of the year 1,718 special offices, each with a mail-carrier whose pay from the Department is not allowed to exceed the net postal yield of the office.

Of public mail-routes in operation there were 9,003, (of which 912 were railroad, being an increase of 41 routes of this class over the previous year,) aggregating in length 281,798 miles; in annual transportation, 136,269,708 miles; in annual cost, \$15,201,140. Adding the compensation of railway-post-office clerks, route-agents, mail-route messengers, local agents, and mail-messengers, amounting to \$3,159,908, the aggregate annual cost will be \$18,361,048.

The service was divided as follows:

Railroad-routes: length, 72,348 miles; annual transportation, 77,741,172 miles; annual cost, \$9,543,134—about 12.27 cents per mile.

Steamboat-routes: length, 14,883 miles; annual transportation, 3,704,533 miles; annual cost, \$606,465—about 16.37 cents per mile.

Other routes, upon which the mails are required to be conveyed with "celerity, certainty, and security:" length, 194,567 miles; annual transportation, 54,824,003 miles; annual cost, \$5,051,541—about 9.21 cents per mile.

There was an increase over the preceding year in length of routes of 3,925 miles; in annual transportation, of 2,447,492 miles; and a decrease in cost of \$152,229. Adding the increased cost for railway-post-office clerks, route, local, and other agents, \$228,107, the total increase in cost was \$75,878.

The railroad routes have been increased in length 2,265 miles, and in cost \$326,616, against an increase last year of 2,349 miles in length, and \$626,855 in cost.

## RE-ADJUSTMENT OF PAY ON RAILROAD ROUTES.

Returns showing the weight of mails and other particulars respecting the service performed on railroad routes in States in which a new contract term commenced on the 1st of July, 1876, as well as in other States and Territories, are given in tables E and F in the appendix.

## FINES AND DEDUCTIONS.

The amount of fines imposed upon contractors, and deductions made from their pay for failures and other delinquencies, for the year was \$122,563.15, and the amount remitted during the same period was \$13,085.49, leaving the net amount of fines and deductions \$109,477.66.

## MAIL BAGS, LOCKS, AND KEYS.

A table appended to this report exhibits in detail the number, description, and cost of mail-bags and mail-catchers, and of mail locks and keys purchased under contracts during the last fiscal year. The total number of mail-bags purchased and put into service was 103,794, of which 80,980 were for the transmission of printed and third-class matter, and 22,814 were chiefly for the transmission of letters or first-class matter. The total cost of mail-bags and mail-catchers, including repairs, labels, &c., amounted to \$208,847.49.

Compared with the preceding year, there was an increase of 23,744 mail-bags and 650 mail-catchers, and of \$21,699.41 in the total cost of mail-bags and mail-catchers, during the last fiscal year; such increase being occasioned by expanded mail facilities. The total cost of mail locks and keys was \$16,720.95. The total cost during the preceding year was \$31,840.

An entire re-organization of the system of repairing mail-bags was effected during the last year, which has resulted in a very great reduction of that item of expense. During the preceding year, under the old system which had prevailed for many years, and under which all repairs were made on special contracts with persons outside of the Department, the cost thereof was \$92,419.95. For the last fiscal year, during which the repairs were all made by persons directly employed at annual salaries in the several post-offices which are mail-bag depositories, the expense was reduced to \$30,161.92—a saving of \$62,258.03.

## MAIL-DEPREDACTIONS.

During the year ended June 30, 1876, 291 persons were arrested for violations of the postal laws and regulations, and given in charge to the United States authorities for trial, with the following results, viz:

Convicted .....	127
Acquitted .....	11
Otherwise disposed of.....	48
Awaiting trial.....	105
<b>Total .....</b>	<b>291</b>

In addition to the above, 148 persons were arrested charged with similar offenses, but as there were circumstances connected with said arrests which made the parties amenable to State laws, it was deemed better to hand them over to the State authorities. These, added to the number held for trial in United States courts, aggregate 439 persons arrested during the year. Of this number, only 151 were employes of the Post-Office Department; and when it is considered that United States mails are transported annually over 136,000,000 miles of mail-routes, and are handled by 50,000 persons, this exhibit will be considered very satisfactory.

The number of recorded complaints during the year is 6,640, involving the loss or rifling of 6,726 letters, aggregating in value, in money, bonds, drafts, &c., \$146,028.29, of which 2,155 were registered, valued at \$25,829.69, and 4,571 unregistered, valued at \$130,198.60. Of the 1,597 registered letters reported missing, 833 were satisfactorily accounted for, and 764, valued at \$16,794.16, are reported as actually lost.

Of the 764 lost, 196, valued at \$4,295.74, were made good; and of the 558 registered letters reported rifled of contents, valued at \$9,478.08, the contents of 77, aggregating in value \$1,861.04, were recovered and restored to the owners. Cases numbering 382 remain in the hands of the special agents under investigation.

The whole number of letters registered throughout the United States during the year ended June 30, 1876, was 4,007,817, while this exhibit shows an actual loss of only 1,049, about  $\frac{2\frac{5}{100}}{1000}$  of 1 per cent., or  $2\frac{3}{4}$  for every 10,000 registered letters mailed.

#### RAILWAY-POST-OFFICE LINES.

A tabular statement hereto appended shows that the number of railway-post-office lines in operation on the 30th of June, 1876, was 63, extending over 17,713 miles of railroad routes; an increase of 1 line and of 781 miles compared with the preceding year.

The number of clerks employed was 1,042, at an annual cost of \$1,278,340; an increase of 141 clerks and \$155,700. Upon 14,591 miles the service is performed daily, and upon 3,122 miles twice daily, equivalent in all to 20,835 miles each way daily.

Counting all the lines both ways, the aggregate service is 41,671 miles daily.

#### POST-ROUTE MAPS.

During the year new post-route maps have been prepared and published of the States of Florida, Kansas, Nebraska, Alabama, Mississippi, and Minnesota. New editions of the various maps previously issued, embracing all the northern and middle States, and some others, have also been issued for the use of the officers and clerks of the Department, as well as to supply the requirements of postmasters, special agents, and the railway mail-service, in properly distributing the mails.

Drawings for maps of the States of Georgia, Arkansas and the In-

dian Territory, Kentucky, Tennessee, and of the greater number of the Territories, were in course of preparation with a view to bringing out engraved or lithographed prints of them during the present fiscal year, only a few of these maps in manuscript being hitherto in existence; but the failure to receive adequate appropriations for this purpose, and the consequent reduction of the force of draughtsmen and clerks, has made it necessary to lay aside almost entirely this desirable work. In the estimates herewith submitted, I have included the amount required for the resumption of this work.

#### FOREIGN MAILS.

The Postal Union treaty, which went into operation at the commencement of the fiscal year, has greatly simplified the operations of our postal exchanges with European countries; as, under its provisions, each country retains to its exclusive use all the postages which it collects. All postage-accounts on the direct correspondence reciprocally exchanged between Postal Union countries have been discontinued, and therefore no record has been kept of the number of letters exchanged, or the amounts of postage thereon, as was the practice under the separate postal arrangements previously in force. The weights, only, of the letter and printed-matter mails dispatched to Postal Union countries have been accurately taken, for the purpose of making payments for the intermediate sea and inland transit charges thereon; which charges are, by the provisions of the treaty, defrayed by the post department of the country dispatching the mails.

The total weights of the mails dispatched from the United States to Postal Union countries during the year were as follows: Letters, 95,984,-186 grams, equal to 3,386,103 ounces; printed matter and samples, 366,-552,486 grams, equal to 12,935,398 ounces—being an increased weight over 1875 of 155,063 ounces of letters and 1,727,567 ounces of printed matter and samples. A statement is appended of the weight of mails dispatched to each Postal Union country.

The reduced rates of transatlantic sea-postage of 6 francs 50 centimes per kilogram of letters and 50 centimes per kilogram of other mail-matter, established by the General Postal Union treaty, have been allowed and paid, at their current gold value, to the respective steamship lines transporting our mails to Europe, with the exception of the American line from Philadelphia to Liverpool, which has received a compensation in excess of the sea-postages, fixed by special agreement, at \$3.25 per kilogram of letters and 10 cents per kilogram of other mail matter.

The cost of the United States transatlantic mail-steamship service for the year 1876 was \$172,343.09, being a reduction of \$55,755.16 from the cost of the same service for the year 1875. The payments made to the respective steamship lines carrying mails to Europe were as follows:

The Cunard line, for 51 trips from New York and 51 trips from Boston to Queenstown and Liverpool.....	\$43,627 79
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The Hamburg-American Packet Company, for 39 trips from New York and 14 trips from Philadelphia to Plymouth, Cherbourg, and Hamburg.....	\$38,863 31
The North German Lloyd of Bremen, for 53 trips from New York and 21 trips from Baltimore to Southampton and Bremen.....	28,680 51
The Liverpool and Great Western, (Williams & Guion,) for 39 trips from New York to Queenstown and Liverpool.....	24,874 85
The White Star line, for 33 trips from New York to Queenstown and Liverpool.....	17,089 72
The Inman line, for 19 trips from New York to Queenstown and Liverpool..	9,281 27
The Canadian line, for 53 trips to Liverpool.....	3,603 05
The Anchor line, for 51 trips from New York to Glasgow.....	2,246 72
The General Transatlantic Steamship Company, for conveying mails from New York to Havre.....	2,076 90
American Steamship Company, for 46 trips from Philadelphia to Queens-town.....	1,996 05
The Netherlands Steam Navigation Company, for 5 trips from New York to Rotterdam.....	2 92
<b>Total.....</b>	<b>172,343 09</b>

The payments made to the respective transatlantic lines, on account of transportation of the British and French closed mails from New York to Europe, were as follows:

To the Liverpool and Great Western Steamship Company.....	\$1,502 80
To the Cunard line.....	2,953 52
To the White Star line.....	54 42
To the Hamburg-American Packet Company.....	517 20
To the North German Lloyd of Bremen.....	499 88
To the Eagle line.....	5,409 57
To the Inman line.....	1,314 99
To the Snow & Burgess line.....	63 98
<b>Total.....</b>	<b>12,316 36</b>

The United States postages on mails conveyed to and from the West Indies, Panama, Central America, Brazil, Mexico, Bermuda, Nova Scotia, New Granada, Venezuela, and Honolulu, at the reduced rates established from July 1, 1875, amounted to \$119,617.68, and the cost of the sea conveyance thereof was \$45,436.79.

The United States postages on mails exchanged with Japan and China, by means of the subsidized line of direct mail steamers, amounted to \$18,679.36.

The total cost of the United States ocean mail-steamship service for the year 1876 (including \$537,500 paid from special appropriation for steamship service to Japan and China and to Brazil) was \$755,279.88, being a reduction of \$231,356.78 from the cost of the same service for the year 1875.

The contract with the Pacific Mail Steamship Company, authorized by acts of Congress approved February 17, 1865, and February 18, 1867, for the conveyance of a monthly mail from San Francisco to Japan and China, will expire by limitation on the 31st of December, 1876, and, in the absence of special legislation by Congress authorizing a continuance



of the mail-service on this important route at a higher rate of compensation, the provisions of the general law, limiting the compensation to be allowed for the transportation of the mails by sea to the amount of postages on the mails conveyed, will become applicable to any steamship service which may be performed on this route on and after January 1, 1877.

It is but just to say that the contractors for this service, notwithstanding serious embarrassments and difficulties, have transported the mails throughout the contract-term of ten years with uninterrupted regularity, and in a manner entirely satisfactory to the Department. The steamships employed in the service were built in the United States, and are first-class in all respects. They constitute, at present, the only American ocean-steamship line, except that now performing weekly trips between Philadelphia and Liverpool; all other transatlantic and Pacific mail-service being performed by steamships sailing under the flags of other nations.

The additional monthly mail service to Japan and China by the Occidental and Oriental line of steamers, (an English line,) for the compensation of the sea-postages, referred to in the last annual report, was abandoned by the owners of said line, who refused to transport the mails on these terms. The Department has also been unable to secure any regular direct mail communication with Brazil for the compensation of the sea-postages.

The general postal union treaty concluded at Berne, October 9, 1874, has been in operation since July 1, 1875, with the most satisfactory results. Our people have enjoyed the advantages of the cheap and uniform postage-rates which have been established to all parts of the civilized world, and the Post-Office Department has also been financially benefited by the greater simplicity of postal operations under its provisions, as well as by the entire suppression of postage accounts on the postal union correspondence. The territory of the union has been greatly enlarged by the accession, from the 1st of July, 1876, of British India, (comprising Hindostan, British Burmah, and Aden,) and the French colonies in America, Africa, Asia, and Oceanica, under an arrangement fixing the conditions of their adhesion to the stipulations of the treaty, signed at Berne, the 27th January, 1876, by delegates of the several postal administrations interested in their admission, a copy of which is appended. British India and the French colonies having been admitted subject to an additional charge of 25 francs per kilogram of letters, and 1 franc per kilogram of printed matter and samples, to cover the expenses of sea-transportation beyond the limits of the postal union as originally formed by the Berne treaty, it was necessary to fix the rates of postage to British India and the French colonies at double the ordinary postal-union rates.

Montenegro, Gibraltar, (as subordinate to the postal administration of Great Britain,) and the islands of Gozzo, Comino, and Cominotto, as

dependencies of Malta, have also been embraced in the postal union on the terms of the original treaty.

Propositions have been formally submitted by the international bureau at Berne to the vote of the postal administrations of the union, for the admission into the union, from the 1st of April next, of all the Spanish and Dutch colonies, and certain of the British colonies, as follows :

1st. To admit into the General Postal Union, from April 1, 1877, upon the same conditions as the French colonies and British India, that is to say, upon the conditions of the arrangement signed at Berne, 27th January, 1876, all of the Spanish colonies and the Dutch colonies, as well as the British colonies of Ceylon, the establishments of Detroit, (Straits Settlements,) Labuan, Trinidad, and British Guiana.

2d. To admit also into the union, from April 1, 1877, and upon the same conditions as the above-mentioned colonies under No. 1 above, the British colonies of the Bermuda Islands and Jamaica, but with the reservation, specially concerning the postal relations between the United States and these two colonies, that the maritime rate of francs 6.50 per kilogram of letters shall replace that of 25 francs, applicable to the relations of all the other union countries with the Bermuda Islands and Jamaica.

This Department has given its assent to the admission of all these colonies into the postal union at the date named, on condition that the reservation made to the admission of the Bermudas and Jamaica, in No. 2 above, be also applied to Cuba, Porto Rico, Curaçoa, and other Spanish and Dutch colonies in the West Indies.

Applications have also been made for the admission into the postal union of the empire of Brazil, Canada, Newfoundland, the Sandwich Islands, Japan, and the British colony of Hong-Kong, but no agreement has been reached in regard to the conditions of their admission.

Many questions relating to the proper construction to be given to provisions of the treaty, and detailed regulations, have been submitted through the international office at Berne for the opinions of the respective postal administrations, and modifications of the provisions thereof have been proposed through the international office, but in the majority of cases they have failed to receive a uniform interpretation or the unanimous vote of the postal administrations required for their adoption, and their consideration has therefore been postponed to the next postal congress, which has been adjourned to meet at Paris in the spring of 1878. The only propositions for changes submitted through the international office which have obtained the unanimous adhesion of all the postal union administrations were as follows :

Article XVIII of the Regulations for the execution of the Berne treaty, relating to statistics of transit, has been modified in certain of its stipulations by adopting a proposition of the postal administration of Germany, formulated as follows :

1st. The statistics from the 1st to 7th August, 1875, shall serve as basis for the accounts from 1st July to 31st December, 1875.

2d. The annual statistics fixed for the 1st December shall not be made in 1875.

3d. The subsequent statements shall be taken from the 1st to 7th June, 1876, and from the 1st to 7th December, 1876.

The results of these statements shall be valid from the 1st of January.

An additional provision, formulated as follows, has also been adopted by a unanimous vote of the postal union administrations :

The territorial transit expenses within the district of the union, of the mails destined for or coming from countries beyond the sea, foreign to the union, shall be calculated according to the statement of weight serving to establish the maritime transit expenses of such mails.

A postal convention has been concluded with the colony of Queensland, Australia, establishing an exchange of correspondence with that colony by means of the colonial contract mail-packets, plying between San Francisco and the colonies. This convention, a copy of which is appended, was carried into operation the 1st of January, 1876.

An additional postal agreement with the empire of Japan, modifying the provisions of the postal convention with that country, and reducing postage rates to the basis established with the postal-union countries was concluded on the 8th of February, and carried into operation on the 1st of April, 1876. A copy is appended.

A postal convention has been concluded with the British colony of Bermuda on the basis of postal-union rates. This convention, a copy of which is annexed, was carried into operation on the 1st of October, 1876.

An additional agreement has been concluded with Newfoundland, reducing the single prepaid letter-rate of postage between the United States and that colony to 5 cents; a copy of which is appended.

Negotiations are also pending for postal conventions with Peru, Victoria, and Chili. That with Chili has been formally executed with the Chilean minister, at Washington, and sent to Santiago for ratification by the Chilean government. It will be carried into operation on the 1st of January next, should the notice of its ratification be received previous to that date.

#### APPOINTMENTS.

The report of the appointment-office shows the following :

Number of post-offices established during the year .....	1,993
Number discontinued.....	1,157
Increase .....	836
Number in operation June 30, 1875 .....	35,547
Number in operation June 30, 1876 .....	36,383
Number filled by appointments of the President.....	1,568
Number filled by appointments of the Postmaster-General.....	34,815

#### Appointments were made during the year—

On resignations and commissions expired .....	5,140
On removals .....	1,045
On changes of names and sites.....	251
On deaths of postmasters.....	333
On establishment of new offices.....	1,993

Total appointments .....	8,762
Number of cases acted on during the year .....	10,114

The number and aggregate compensation of special agents, route agents, mail-route messengers, railway post-office clerks, and local agents in service during the year ended June 30, 1876, were—

*43 special agents .....	\$142,061 92
1,042 railway post-office clerks .....	1,278,340 00
1,017 route-agents .....	975,280 00
219 mail-route messengers .....	145,610 00
137 local agents .....	104,910 00
<hr/> 2,458	<hr/>
Total .....	2,646,201 92

The following table shows the number of employés in the Post-Office Department; also the number of postmasters, contractors, clerks in post-offices, route-agents, railway post-office clerks, and other officers in service June 30, 1875, and June 30, 1876, respectively :

Departmental officers and employés :		1875.	1876.
Postmaster-General .....		1	1
Assistant Postmaster-General .....		3	3
Superintendent of foreign mails .....		1	1
Superintendent of money-order system .....		1	1
Chief clerk to the Postmaster-General .....		1	1
Chief of division of dead-letters .....		1	1
Chief of division of depredation .....		1	1
Chief of division of postage-stamps, stamped envelopes, and postal cards .....		1	1
Topographer for Department .....		1	1
Chief clerks of bureaus .....		5	5
Disbursing officer and superintendent of building .....		1	1
Stenographer .....			1
Clerks, messengers, watchmen, &c .....		367	363
		<hr/> 384	<hr/> 381
Other officers and agents :			
Postmasters .....	35,547	36,383	
Contractors .....	6,280	6,126	
Clerks in post-offices .....	4,467	4,718	
Letter-carriers .....	2,195	2,269	
Route-agents .....	987	1,017	
Railway post-office clerks .....	901	1,042	
Mail-route messengers .....	225	219	
Local agents .....	125	137	
Special agents .....	66	62	
	<hr/>	<hr/>	<hr/>
Total in service .....	51,177	52,354	

#### FREE DELIVERY.

No additions to the number of free-delivery offices were made during the year. The service was, however, improved in several of the cities by establishing branch offices and extending the carriers' delivery. Two branch offices were established in Cleveland in place of two small offices, one in Brooklyn, and two in Philadelphia.

\* Other special agents charged to separate appropriations.

A centennial branch of the Philadelphia post-office, fitted up in excellent style and complete in all its appointments, was located in the Government building in the exhibition grounds for the accommodation of the foreign and domestic officials and exhibitors and the large numbers of persons in daily attendance on the exhibition. It was equipped with all the requisites and conveniences of a first-class post-office, with letter-boxes for the reception of mail-matter located at all the principal points in the exhibition buildings and grounds, and, with its corps of ten letter-carriers, supplied every practicable facility to the officials, exhibitors, and visitors for the frequent and prompt collection, transmission, and delivery of their correspondence. As the business of this branch office was chiefly transacted in the current fiscal year, a detailed statement of its operations is reserved for the next annual report.

The general results of the service during the year are satisfactory. The postage on local matter exceeded the entire expense by \$84,375.22.

The increase in the cost of the service was but 5 per cent., while the increase in the postage on local matter was 6 per cent. The average cost per piece of handling the matter was 3.13 mills. The aggregate results for the fiscal year ending June 30, 1876, were as follows :

		Increase over preceding year.
Number of officers .....	87	.....
Number of letter-carriers .....	2,269	74
Mail-letters delivered .....	189,659,443	10,575,975
Mail postal cards delivered .....	23,952,381	5,638,816
Local letters delivered .....	53,773,953	4,934,716
Local postal cards delivered .....	19,963,290	3,937,078
Registered letters delivered * .....	1,069,698	.....
Newspapers delivered .....	80,675,040	12,220,564
Letters collected .....	200,230,079	12,329,438
Postal cards collected .....	33,950,503	5,747,035
Newspapers collected .....	28,453,086	1,122,679
Whole number of pieces handled .....	631,777,473	57,575,999
Pieces handled per carrier .....	278,438	16,843
Total cost of service .....	\$1,981,186.51	} \$101,144.52 or 5 per cent.
Average cost per piece in mills † .....	3.13	
Average cost per carrier † .....	\$871.08	.....
Amount of postage on local matter .....	\$2,065,561.73	} \$118,002.19 or 6 per cent.
Excess of postage on local matter over the total cost of service .....	\$84,375.22	

In consequence of the reduction made by Congress at its last session in the appropriations for the free-delivery service, I was compelled to further reduce the salaries paid to the hard-worked and faithful letter-carriers in cities where the free-delivery system has been established.

A tabular statement, marked A, exhibiting in detail the operations of the free-delivery service for the past fiscal year, will be found in the appendix.

\* Not reported last year.

† Based on the aggregate (\$1,976,486.85) paid carriers, including incidental expenses at the several offices.

## POSTAL MONEY-ORDER SYSTEM.

At the close of the fiscal ended June 30, 1875, the number of domestic money-order offices was 3,401. The number of new offices established during the following year was 305, and the number discontinued was 9, making a total of 3,697 offices in operation June 30, 1876.

During the last fiscal year 4,998,600 domestic money-orders were issued, whose aggregate value was \$77,035,972.78. The number of such orders paid was 4,947,685, amounting in value to \$76,632,571.45. To the total amount of orders paid is to be added \$473,767.40, the amount of orders repaid to remitters, making the total payments \$77,106,338.85, and the excess of the payments over the issues \$70,366.07.

The total amount of fees received by postmasters for the issue of domestic money-orders was \$645,699.40.

The foregoing statement of the year's transactions, when compared with that of the preceding year, shows a decrease of \$395,277.80, or one-half of one per cent., in the amount of orders issued; a decrease of \$232,782.30, or three-tenths of one per cent., in the amount of orders paid, and a *gain* of \$152,687.96, or 31 per cent., in the amount of fees received.

The past fiscal year is the first, since the establishment of the money-order system, in which there has been a decrease in the number or amount of domestic money-orders issued or paid. This decrease is believed to have been caused, for the most part, by the continuance of the financial depression which affected unfavorably to so great an extent the use of the money-order system, in the direction of its employment for business purposes, during the preceding year.

The average amount for which domestic money-orders were issued during the year was \$15.41, being 6 cents less than the average of the previous year.

The total number of duplicate money-orders issued was 17,451, of which 37 were afterward canceled, leaving 17,414 as the number actually used, being a decrease of 3,276, or 16 per cent., during the year. Of this number 17,114 were issued in lieu of money-orders lost in the mails, or which, by reason of imperfect address or from some unknown cause, had failed to reach the payee in due time; 181 were issued in lieu of money-orders alleged to have been lost by the remitters or payees; 13 were issued to the remitters in lieu of money-orders, payment of which had been prohibited, in pursuance of the provisions of section 3929 of the Revised Statutes of the United States, because drawn in favor of the proprietors or agents of fraudulent lotteries, gift-enterprises, or other "schemes or devices for obtaining money through the mails by means of false or fraudulent pretenses, representations, or promises;" 69 were in lieu of orders which had become invalid because not presented for payment within one year after the date of their issue; 7 were in lieu of orders invalidated by reason of their having received more than one indorsement, and 30 in lieu of orders burned in the mails.

The Auditor has reported the following statement, showing the revenue which accrued on domestic money-order transactions for the fiscal year ended June 30, 1876 :

Fees received on domestic money-orders issued .....	\$645,699 40
Premiums, &c., received .....	1,322 12
<b>Total .....</b>	<b>647,021 52</b>
Commissions and clerk-hire.....	\$420,487 42
Incidental expenses .....	30,800 09
Lost remittances .....	4,960 64
Bad debts.....	2 53
<b>Net revenue.....</b>	<b>190,770 84</b>
	<b>647,021 52</b>

This amount of revenue is \$70,628.75 greater than that of the previous year, being a gain of nearly 59 per cent.

In compliance with the provisions of the act of March 3, 1875, the increased schedule of fees for the issue of domestic money-orders went into effect on the first day of the following July. By this act, the fee on each order not exceeding \$10, and on each order over \$15 and not exceeding \$20, was made 5 cents greater than the fee previously charged for the issue of orders of the same class. When the passage of this act was recommended, it was believed that the proposed increase would yield a gross annual revenue equal to the entire amount of expenditures of all kinds incurred on account of the money-order system, including the cost of Department clerical labor, printing blanks and stationery, now, as heretofore, paid out of the general appropriations. The result of the first year's experience under the operation of the act above referred to has been an increase of \$152,687.96, or 31 per cent., in the amount of fees received for the issue of domestic money-orders, notwithstanding the falling off of one-half of one per cent. in the amount of the orders; yet that the purchase of money-orders for small amounts has not been, to any appreciable extent, unfavorably affected by the increase of the fee is shown by the trivial decrease of 6 cents in the average amount for which money-orders were issued during the year. The items of expense paid out of general appropriations were, the salaries of the Superintendent's Office, \$34,776.57; the salaries in the Auditor's Office, \$94,500; books, blanks, and printing, furnished by the Congressional Printer, for the money-order system, \$54,169.36; and blanks, books, and stationery, not included in the last item, estimated at \$5,000, being a total of \$188,445.93, or \$2,324.91 less than the amount of the net revenue reported by the Auditor as having accrued from the transaction of the domestic money-order business at post-offices throughout the country. To this surplus of net revenue from the domestic money-order business of \$2,324.91 should be added an amount of not less than \$10,000, being the estimated net proceeds of the money-order business with foreign countries during the last year, not yet ascertained by the Auditor.

Certain of the larger offices are designated as "money-order offices of the first class," or depositories for surplus money-order funds, which accumulate from time to time at offices which issue money-orders to a greater amount than they pay. Postmasters who are unable to procure drafts of national banks by means of which to remit their surplus funds to some designated office of the first class for deposit, are instructed to forward such funds through the mail in registered letters. The sum of \$54,285,551.15 of surplus funds was deposited with the postmasters of offices of the first class during the year. Nearly the whole of this amount was transmitted through the mails. Sixty-nine cases of remittances of surplus funds reported as lost, amounting to \$12,704.61, were under investigation during the same period. Forty-one of these, amounting to \$7,875.61, were reported as pending at the close of the previous fiscal year; four, amounting to \$306, occurred during that year, but were not brought to the knowledge of the Department until after the publication of the last annual report; and twenty-four, amounting to \$4,523, occurred within the year. In 25.43 of these cases, the amount, \$5,410.64, was allowed to the postmasters by whom the remittances were made, as the losses were found to have occurred without their fault; in 19.57 cases the amount, \$2,780.97, was recovered by special agents; and 24 cases, amounting to \$4,963, were unsettled at the close of the fiscal year.

The amount of money-orders paid by certain offices is, either continuously or occasionally, greater than the amount of the orders issued by them. To enable such offices, east of the Rocky Mountains, to pay without delay the orders drawn upon them, credits with the postmaster at New York, to a definite amount in each case, are allowed, and a limited supply of blank drafts are furnished, to be drawn against such credits as the exigencies of their business may demand. The postmaster at New York has paid drafts of this class amounting to \$6,803,014.67 during the year. Postmasters in the States of the Pacific coast have been furnished with funds to the amount of \$66,337 by the postmaster at San Francisco, Cal., and to the amount of \$40,582 by the postmaster at Portland, Oreg., to meet similar exigencies of the service in those States.

Out of the total number of domestic money-orders paid during the year, the payment of forty-two, amounting to \$1,083.97, was alleged to have been made to persons fraudulently representing themselves to be the payees, or their indorsees or agents, and who obtained payment by forging the signatures of such payees or indorsees, or by other improper or unlawful means, being at the rate of one reported erroneous payment in 117,802. Seventy-seven claims for re-imbursement, growing out of such alleged erroneous payment, amounting to \$2,122.20, were under investigation during the year, twenty of which, amounting to \$654.24, were reported as pending at the close of the previous year; seven, amounting to \$164.78, occurred before June 30, 1875, but were inadvert-



ently omitted from the last annual report; eight, amounting to \$219.21, occurred previously to that time, but failed to be brought to the knowledge of the Department until after the publication of the last report; and forty-two, amounting to \$1,083.97, as hereinbefore stated, occurred during the year. In four of these cases the amount, \$75.45, was ascertained to have been paid to the rightful owner; in one the amount, \$35.06, was charged against the remitter; in five the amount, \$108.71, was charged against the payees; in fifteen cases, amounting to \$269.10, the money was refunded by the paying postmasters through whose negligence the losses occurred; in ten the loss, amounting to \$415.44, was assumed by the Department; in ten the amount, \$225.78, was recovered by special agents from the persons by whom the forgeries had been committed; and thirty-two cases, amounting to \$992.66, are still unsettled.

The number of offices authorized to issue money-orders payable in Switzerland, and to pay orders drawn in that country, was 174 on the 30th day of June, 1875. Within the last fiscal year 6 offices have been added to the list and 1 discontinued, leaving 179 in operation at its close. The number of Swiss money-orders issued in the United States was 3,457, amounting to \$83,256.63, and the number paid was 1,493, amounting to \$38,394.29. This amount of business, compared with that of the previous year, exhibits an increase of \$14,708.57, or 21.46 per cent. in the issues, and \$9,258.51, or 31.78 per cent. in the payments. The fees received amounted to \$2,347.25.

The number of offices authorized to issue money-orders payable in the United Kingdom of Great Britain and Ireland, and to pay orders drawn in that country, was 993 on June 30, 1875. During the year 25 offices were added to the list and 5 discontinued, leaving 1,013 in operation at its close. These offices issued 59,083 British money-orders, amounting to \$1,018,355.15, and paid 20,586, amounting to \$372,288.63. In comparison with the business of the preceding year, these transactions show a decrease of \$131,027, or 11.40 per cent., in the issues, and an increase of \$47,745.83, or 14.71 per cent., in the payments. The fees received amounted to \$31,256.10.

The number of offices authorized to issue money-orders payable in the German Empire, and to pay orders drawn in that country, was, on the 30th of June, 1875, 604. During the year 30 have been added to the list and 3 discontinued, leaving 631 in operation at its close. The whole number of German money-orders issued was 38,174, amounting to \$780,060.52, and the number paid was 28,879, amounting to \$729,672.66, showing, in comparison with the transactions of the previous year, a gain of \$33,415.98, or 4.48 per cent. in the issues, and \$108,915.90, or 17.54 per cent. in the payments. The fees received amounted to \$21,448.10.

On August 2, 1875, the exchange of money-orders between the United States and the Dominion of Canada was commenced under the provisions of the postal convention of June 8, 1875, referred to in the last

annual report. During the year 316 offices were authorized to issue money-orders for payment in the Dominion, and to pay orders drawn in that country. In the eleven months in which the business was in operation 8,695 Canadian money-orders, amounting to \$186,995.74, were issued, and 11,783, amounting to \$232,625.57, were paid. The fees received amounted to \$4,284.85. An arrangement was also made during the year by which money-orders are issued through the Canadian post-office department payable in the province of Nova Scotia, and by the same means orders issued in that province are paid in the United States.

The gross number of domestic and international money-orders issued during the year was 5,108,009, amounting to \$79,104,640.81, and the gross number paid was 5,010,426, amounting to \$78,005,552.60.

The Auditor is unable at present to furnish an exact statement of the revenue of the last fiscal year from the exchange of money-orders with the foreign countries with which money-order conventions are in force, as a final adjustment of the accounts of the last quarter of that year, to be made by him and the proper accounting officers of those countries, has not been reached. The revenue of the previous year derived from the Swiss business was stated in the last annual report, viz, \$679.11; that from the British business for that year is reported by the Auditor at \$833.59, and from the German business at \$7,816.47.

#### MISCELLANEOUS.

##### SALARIES OF POSTMASTERS.

I renew the recommendation of my predecessor in his last annual report for a change in the basis of adjusting the salaries of postmasters at fourth-class offices. Prior to July 1, 1874, the salaries were based mainly upon the amount of stamps canceled; but since then, by acts of June 23, 1874, and July 12, 1876, commissions have been allowed on the revenues, which are derived mostly from the sale of stamps. That the change was not correct in principle must be apparent upon reflection, and that it has not been advantageous to the Département is demonstrated by experience. The old plan was the more equitable one, for the reason that the stamps canceled in a post-office represent the amount of labor performed in handling matter for mailing, while the sale of stamps is no test of the work required of the postmaster. Under that plan postmasters were required to render sworn statements of the amount of stamps canceled for a fixed period; and the sales of stamps shown in the quarterly accounts-current operated as a check upon these statements, as, under a legitimate mode of doing business, there must ordinarily be a near correspondence between the amount of stamps sold and the amount canceled. Under the present system, there is nothing in a postmaster's returns to detect improper sales. Stamps can be furnished him to the extent justified by his bond, and all that is required of him is to account for the proceeds. He is not obliged to state under oath or otherwise in

what manner or to whom he disposed of them. Practically, he has only the fear of removal, upon a chance discovery, to prevent him from traversing the country seeking purchasers, and offering such liberal discounts as his own large commissions will afford.

To show how great the inducement is, it need only be mentioned that the sales at an office must exceed \$1,200 per annum before the commissions fall below 50 per cent.

Were the commissions uniform throughout, the matter would regulate itself, one postmaster's gain being another's loss; but graded as they are upon a scale, and stopping at a fixed point, the Government is a loser whenever stamps are sold by the postmaster of a small office within the delivery of a larger one. Naturally the abuse is apt to be in this direction. Not only do the cities and large towns offer greater facilities for the sale or exchange of stamps, but in such places the chances of detection are greatly lessened. With the mutual interest for concealment between buyer and seller, detection is more likely to be the exception than the rule.

Stamps are used largely as a medium of exchange in lieu of currency, and many are the remittances made of them to the large cities in payment of small bills. Notably is this the case with newspaper subscriptions and orders for books, for which purposes they are very convenient and are often solicited. Not only do publishers in this way procure stamps sufficient for their postages, but they have not infrequently asked the Department to redeem a surplus. Postmasters, as a class, take the lead in getting up subscription clubs, and when using stamps for payment, have the double advantage of getting a commission from the publisher and one from the Government.

In many cases business men engaged in the large cities reside in country places on the lines of public travel, and it is only natural that, in their desire to serve a neighbor, they should purchase their stamps of the country postmaster for use in the city. It is not likely, however, that they would carry out their letters to be mailed at the country post-office.

Railroad, insurance, and express companies and other large corporations, who have many agents among the country postmasters, may obtain from this source the large amounts of stamps required for use at their city headquarters, and thus indirectly, but systematically, contribute to their own revenues. And traveling commercial agents may realize a handsome profit by purchasing stamps at a large discount from country postmasters, perhaps in exchange for goods, and reselling them in the cities at a smaller discount.

I have before me a list of 50 offices, hastily selected, at which the aggregate compensation for the two years ending June 30, 1874, under the old law, was \$12,126, and for the two years ending June 30, 1876, under the new law, \$64,051.51, or an average of \$242.52 to each office under the former, and of \$1,281.03 under the latter, and an average in-

crease of \$1,038.51, or 428 + per cent. Nearly all of these offices, which are but representatives of their kind, are located in close proximity to some city, and from what has already been explained, the reasons for such a large increase will be readily apparent.

It has been frequently found that an outgoing postmaster has neglected or refused to turn over to his successor the stamps remaining in his hands, preferring to account for them as sold, and thus getting the commissions allowed by law. By afterward selling the stamps to the public he would actually receive the emoluments of the office while the new postmaster was doing the work.

There is ample evidence in the Department to establish the prevalence of the abuse in all the various forms that have been suggested.

It is evident that if the abuse is to be prevented or checked to any extent, it must be through the supply of stamps; but that is a matter difficult to regulate, it being impossible for the Department to know the precise relative wants of the 36,000 or more communities, represented by as many post-offices, throughout the United States. To withhold supplies pending investigations is to incommode the public, bring the Department into discredit, and in some degree to impair its revenues. It is at least unfortunate that the present law forces upon the Department a conservative policy in the supply of stamps—a policy that is justified by no law of business. The issue and sale of stamps should be encouraged to the fullest possible extent. I deeply regret the necessity of an existing general order circumscribing sales; and although removals have followed well-authenticated violations of this order, the evil seems to be increasing rather than diminishing.

Now as to financial results: During the two years ending June 30, 1874—the period covered by the last biennial re-adjustment under the old law—it required 27.5 per cent. of the sales of stamps to the public to pay the compensation of postmasters; and for the ensuing two years, ending June 30, 1876, under the new law, it required 29.43 per cent. of the sales to pay the compensation. This latter ratio would have been much larger had it not been for the change which took effect on the 1st of January, 1875, in the mode of collecting postage on second-class matter. Prior to that date it was collected in money at the offices of delivery, and under the old law postmasters were allowed 50 per cent. of the amount in the way of compensation; but since then it has been prepaid at the mailing-offices with special adhesive stamps. The offices of delivery are generally the smaller or fourth class offices, and the mailing-offices, at places of publication, are mainly those of the first, second, and third classes, subject to presidential appointment, and at which there had previously been assigned annual salaries, at a fixed amount, for the two years commencing July 1, 1874. The change thus deprived the smaller offices of the commissions on second-class matter, without benefiting the larger ones, and had the double effect of decreasing the compensation of postmasters and of increasing the sales of stamps.

To show what a considerable item this is, it need only be mentioned that the amount of postage collected on second-class matter during the last fiscal year was \$1,014,154.27.

In further support of the argument advanced, it may be stated that for the six months ending December 31, 1874, before the change with reference to second-class matter went into effect, it took 31.13 per cent. of the sales of stamps to pay the compensation of postmasters. This was at the very commencement of the new salary law, and before postmasters had fairly learned how to take advantage of it.

In view of the facts, I urgently recommend that the compensation of postmasters of the fourth class be based upon the business of their respective offices, as ascertained from sworn returns to the Auditor of stamps canceled.

#### STRAW-BIDS.

During the last fiscal year the loss and annoyance to the Department occasioned by the vicious system of "straw-bids" almost wholly disappeared. In all cases of failure by bidders to execute contracts under the law, and by contractors to perform service in accordance with their contracts, suits were promptly commenced on their bonds and pressed to final judgment. The number of failures was less than in any other year for a long period of time past, and the loss to the Department resulting therefrom was considerably decreased. In fact, it may be stated that the failures were no greater in number or amount than would naturally occur under the most stringent law that could be enacted.

By the aid of the law passed at the late session of Congress requiring the sureties on the bonds of bidders to make sworn statements, specifying the location, place of record, and probable value, above incumbrances, of the real estate owned by them, and imposing penalties for making false statements, I am confident the Department will be fully protected against worthless bids; and the other provisions of the law which direct the Postmaster-General, in case a bidder fails to enter into contract or to commence performance of service, to contract with any person, whether a bidder or not, who will perform the service at the lowest price, amply fortify him in his efforts to break up a practice by which the "star service" has so long been at the mercy of combinations formed for corrupt and fraudulent purposes. The complete eradication of the practice can only be prevented by his failure to exercise the authority with which he is clothed.

#### REDUCTION OF PAY TO RAILROADS.

The cost of inland mail-transportation by railroad was so materially changed by the legislation of Congress, at its last session, that I deem it proper to call attention to it, although it does not belong to a report of the operations of this Department during the last fiscal year.

By the act of July 12, 1876, providing appropriations for the service

of the Post-Office Department for the fiscal year ending June 30, 1877, a reduction of ten per centum, to take effect July 1, 1876, was required from the pay of railroad companies for carrying the mails. At that date the cost of such service (most of it adjusted under the provisions of the act of March 3, 1873, a portion, however, only estimated) was \$9,757,546. A further reduction of 20 per centum was also provided for by the act of July, 1876, from the compensation of certain railroad companies whose roads were built, in whole or in part, by the aid of land-grants authorized by congressional legislation.

At the date of the approval of said act a number of railroad companies were under contract, duly executed in accordance with law, to carry the mails during a period not then expired, at a rate of compensation which had been fixed by the provisions of the act of March 3, 1873. Some of these companies raised the question as to whether the reduction required by the subsequent law could be legally made from their pay during the period of their contracts, which question was referred to the Assistant Attorney-General for the Post-Office Department, who decided that they were not affected by it. This question was, however, subsequently submitted to the Attorney-General, whose opinion has not yet been rendered.

The act of March 3, 1873, also fixed a separate compensation for the use of post-office cars furnished by the companies over whose lines the railway-distribution system had been or might be established, and the question was raised as to whether the 10 per cent. reduction subsequently provided for by the act of July, 1876, applied to such compensation. It was held that it did not.

The pay of railroad companies under contract (which, under the opinion of the Assistant Attorney-General for the Post-Office Department, as stated above, were not affected by recent legislation) amounted in the aggregate to \$2,495,646, leaving the sum of \$7,261,870, representing, at that date, the pay of the companies not under contract. The 10 per cent. reduction, amounting to \$726,187, applied to them. A further reduction of \$260,714 was made from the pay of "land-grant railroads," so that the cost of this service, by the operation of the act of last July, was, on the 1st day of July, 1876, decreased in the sum of \$986,901.

#### WITHDRAWAL OF FAST-MAIL TRAINS.

The reduction thus provided for was met on some of the great trunk-lines by the withdrawal of the fast mail which had been previously established. Over the New York Central and Hudson River, and the Lake Shore and Michigan Southern Railroads, an exclusive mail-train, composed of finely equipped postal cars, which were provided with all the conveniences necessary to rapid and perfect distribution, was, for a few months, run between New York and Chicago, on a schedule time of twenty-six hours between those cities; and over the Pennsylvania Railroad and its connecting lines a limited mail-train, with superior ac-

commodations, was run between New York, Cincinnati, Indianapolis, and Saint Louis; the time occupied between New York and Cincinnati, via Philadelphia, Harrisburgh, and Columbus, being twenty-four hours, between New York and Indianapolis, twenty-six hours, and between New York and Saint Louis thirty-three hours. These lines afforded facilities for the transmission of mails from the great commercial center of the East to all points in the West and Southwest, hitherto unknown in the history of railway transportation in this country, and enabled the Department to so completely meet the demands upon it for speedy transportation that the most sanguine expectations of the business communities dependent upon them for postal supplies were more than realized.

It was claimed by the railroad companies at the organization of this expedited distribution system that the rates of pay then provided by existing law were insufficient to compensate them for the extraordinary expense incurred in running trains at such a speed, and there is good reason to believe that they offered their trains to the Department as an experiment, out of a spirit of enterprise, rather than an expectation of deriving immediate profit therefrom.

Serious embarrassments have resulted from a discontinuance of these fast lines, which have been augmented by the refusal of the railroad companies to re-establish the incomplete accommodations they had previously furnished. The mails are now conveyed between the Atlantic seaboard and points in the West and Southwest with less dispatch, and with smaller facilities for distribution, than were provided before the inauguration of the fast-mail system. To be thus compelled to go backward in the work of insuring speedy transmission and perfect delivery of the important business correspondence of the country is a source of mortification to all the officers of this Department whose duties are connected with mail-transportation. Instead of retrograding, the mail system ought to soon attain such perfection as to insure the transportation of letters, and all other matter not too bulky, from one important point to another within the time required to convey passengers between the same points over the speediest lines of communication.

The law of Congress which required a reduction in the pay of railroad companies for carrying the mails, also authorized the appointment of a commission of three skilled and competent persons to investigate the whole subject of mail-transportation by railroad, with a view to making their report the basis of future legislation. The three gentlemen designated by you for that mission entered on their work about the first of last August, since which time they have visited all the large cities and important railroad centers of the United States, and conferred with the managers of the leading railroad lines, and also with intelligent men, representing the main business interests at each point. They seem to have been patient and impartial in collecting information, which will, no doubt, throw much light on the difficult question of determining the proper mode of compensating railroad companies for carrying the mails, and the rates of pay which ought to be fixed for this service.

I have carefully avoided any expression of opinion, the presentation of any theory, or the tender of any advice, which could, in the most remote manner, influence the judgment of this commission; but I can now, with entire propriety, recommend that whatever legislation may result from their investigations shall definitely prescribe fixed rates of mail pay for this service, leaving nothing open to the descretion of the Postmaster-General; and that the execution of written contracts by railroad companies shall be required as a condition of payment for the service which they perform. Less than one-fifth of the railroad service of the country has been, as a general rule, covered by written contracts, and innumerable complaints, misconstructions, and difficulties have grown out of this loose way of doing a business which annually amounts to millions of dollars.

#### INTERFERENCE WITH POSTAL OFFICERS AND EMPLOYÉS.

Indefinite information has occasionally been communicated to this Department of the threatened violence to persons employed by it in some of the States because of their political opinions and party associations. A few postmasters in the Southern States have expressed great apprehension of their personal safety on account of their connection with the postal service, and have specially requested that their reports of apprehended danger should not be made public, lest it should result in the loss of their lives. But no positive testimony of actual interference with such officers or employés while in the discharge of their official duties has been submitted, except in the case of a mail-messenger at Spartanburgh, in the State of South Carolina, who reported through one of the officers of the Department that he had been violently driven away while in charge of the mails, on account of his "political affiliations." The representations of this messenger were referred to an assistant superintendent of the railway mail-service for confirmation of their correctness, who responded that the messenger had disappeared from his post of duty, leaving his work to be performed by a substitute.

What the "affiliations" of this employé were, does not appear from his statement or that of the officer who investigated the case, but the fact of his having been improperly interrupted in the performance of his duties seems to have been corroborated by his disappearance immediately thereafter. I refer to this case because, in my judgment, it is sufficiently suggestive to justify me in recommending that a more severe punishment should be provided for the offense of assaulting any person in charge of the mails, or of retarding or otherwise obstructing them by threats of personal injury.

#### TRANSIT CHARGES ON BRITISH CLOSED MAILS.

A special arrangement has been concluded with the general post-office of the United Kingdom of Great Britain and Ireland, a copy of which is appended, fixing the rates of territorial transit charges on the British



closed mails conveyed across the American continent between Boston or New York and San Francisco at 6 francs per kilogram of letters, and 2 francs per kilogram of newspapers, other printed matter and patterns, and samples of merchandise. The British and Australian mails which are now forwarded by the way of the United States are of great bulk and weight, averaging about 12 tons per month; and as the transit charges thereon, accounted for under the provisions of the postal convention of November 7-24, 1868, were wholly insufficient to defray the actual cost to this Department of their transportation by rail between New York and San Francisco, it became necessary, in order to save the revenues of this Department from the heavy losses incurred on account of their transmission across our territory, to increase these transit charges to the amounts agreed upon in this arrangement.

#### POSTAL DEFICIENCIES.

A very gratifying result is presented in the fact that the deficiency of this Department during the last fiscal year was reduced to \$4,081,790.18, as against \$6,169,938.88 of the preceding year. The difference can be traced to the large increase in its ordinary receipts, (which greatly exceeded the estimates therefor,) and a slight decrease in its expenditures. The growth of the service in all of its branches, as will be seen by reference to the tables in the appendix, has substantially kept pace with the increase of former years. The additional miles of service established equal or exceed the number added during any one year for several years past; the decrease in the proportional cost thereof having resulted from the low rates at which the new service put into operation at the commencement of the fiscal year was let. The bids on nearly all the routes were lower than they had ranged for similar service for many preceding years, and the rigid enforcement of the law against the few bidders and contractors who failed had the effect to induce others to execute their obligations.

It will be instructive to study the variance in the percentage of increase and decrease in the receipts, expenditures, and deficiencies of the postal service for the last seven years. Its ordinary revenues have advanced beyond its expenses, as will more satisfactorily appear from the figures given below:

The ordinary receipts for the year ended June 30, 1876, were.....	\$28,644,197 50
For the year ended June 30, 1869, they amounted to.....	18,344,510 72

Showing an increase of.....	10,299,686 78
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It will thus be seen that in seven years the receipts have increased 56.14 per cent., or at an average of over 8 per cent. per year.

For the same years the expenditures were as follows:

For the year ended June 30, 1876.....	\$33,263,487 58
For the year ended June 30, 1869.....	23,698,131 50

Showing an increase of.....	9,565,356 08
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The increase in the expenditures for the entire period is 40.38 per cent., or at an average rate of about 5.50 per cent. per year.

For the same years the deficiency in the revenues were as follows :

For the year ended June 30, 1876 .....	\$4, 619, 290 08
For the year ended June 30, 1869 .....	5, 353, 620 78

Showing a decrease of deficiency of.....	734, 330 70
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A decrease of deficiency of 13.71 per cent., or at an average rate of nearly 2 per cent. per annum.

If a corresponding ratio of percentage in receipts and expenditures shall be steadily maintained in future years, there is reason to believe the postal service will cease to be a burden on the general treasury. It cannot, however, be speedily brought to a self-sustaining basis; it must reach that point by slow marches, with the aid of wise administration and judicious economy. Whatever theories may be advanced to relieve it of chronic deficiencies, they must yield to the ever-present necessity of supplying abundant mails for the whole country by liberal appropriations and reasonable expenditures. The public would condemn the experiment of higher rates of postage in the attempt to acquire greater revenues, and the experiment itself would fail of its object; while a limited and stinted service would provoke criticism and general complaint. It is apparent, therefore, that such revenues as are essential to make the Department self-supporting cannot be obtained from increased rates of postage; they can only come from active, intelligent, and prosperous communities, evenly and thickly scattered over the several States and Territories. Extravagant outlays, even for frequent mails, would not challenge public approval, but no condemnation would follow wise expenditures for rapid, safe, and frequent mail communication between our widely-separated sections of country. The fact that in only seven of the States and two Territories the receipts equal the expenditures, is sufficient to show that a long time must elapse before the remainder will be able to bear their share of a self-sustaining service. So long as the Post-Office Department must follow the pioneer to the remotest settlements, and put him in communication with the centers of trade and business, and also carry the mails to towns and cities in the first years of their existence as frequently as they are conveyed to those of larger population and more matured growth, so long the general treasury will probably have to bear a part of the cost. When our new States and Territories shall become more populous, and our inexhaustible resources more generally developed, the earnings of the Department will be more than sufficient to defray its expenses.

Very respectfully, your obedient servant,

JAS. N. TYNER,  
*Postmaster-General.*

The PRESIDENT.

## APPENDIX.

### No. 1.—*Estimates for expenditures for the fiscal year ending June 30, 1878.*

#### Office of the Postmaster-General:

Mail depredations and special agents .....	\$160,000 00
Advertising .....	92,500 00
Preparation and publication of post-route maps .....	30,000 00
Miscellaneous items in the office of the Postmaster-General .....	1,500 00
<b>Total .....</b>	<b>\$284,000 00</b>

#### Under First Assistant Postmaster-General:

Compensation to postmasters .....	7,500,000 00
Clarks in post-offices .....	3,700,000 00
Letter-carriers .....	2,100,000 00
Wrapping-paper .....	25,000 00
Twine .....	55,000 00
Marking and rating stamps .....	10,000 00
Letter-balances and scales .....	6,000 00
Rent, fuel, and light .....	450,000 00
Office-furniture .....	30,000 00
Stationery .....	55,000 00
Miscellaneous and incidental items .....	145,000 00
<b>Total .....</b>	<b>14,076,000 00</b>

#### Under the Second Assistant Postmaster-General:

Inland transportation, railroad .....	10,230,745 00
Inland transportation, other than railroad .....	6,237,993 00
Railway post-office clerks .....	1,355,040 00
Route-agents .....	1,071,000 00
Mail-route messengers .....	161,175 00
Local agents .....	114,450 00
Mail-messengers .....	704,025 00
Mail locks and keys .....	20,000 00
Mail-bags and mail-bag catchers .....	225,000 00
<b>Total .....</b>	<b>20,119,428 00</b>

#### Under the Third Assistant Postmaster-General:

Postage-stamps .....	150,747 48
Expenses of agency .....	8,100 00
Stamped envelopes and newspaper-wrappers .....	616,635 39
Expenses of agency .....	16,300 00
Postal cards .....	303,771 56
Expenses of agency .....	7,300 00
Registered-package envelopes, locks, and seals .....	40,000 00
Post-office and dead-letter envelopes .....	42,150 00
Ship, steamboat, and way letters .....	7,500 00
Engraving, printing, and binding drafts and warrants .....	1,500 00
<b>Total .....</b>	<b>1,194,004 43</b>

#### Under the Superintendent of Foreign Mails:

Transportation of foreign mails .....	250,000 00
Balance due foreign countries, including the United States portion of the expense of the international office organized under the provisions of article 15 of the general postal union treaty, concluded at Berne October 9, 1874 .....	50,000 00
<b>Total .....</b>	<b>300,000 00</b>
Official stamps and stamped envelopes for the use of the Post-Office Department during the year .....	750,000 00

**Total estimated expenditures .....** 36,723,432 43

Amount which will be provided by the Department from its own revenue accruing from postages and other sources, estimated .....	\$30, 645, 165 00
Excess of expenditures to be provided for by appropriation out of the general Treasury .....	6, 078, 267 43

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

POST-OFFICE DEPARTMENT, APPOINTMENT OFFICE,  
Washington, D. C., November 4, 1876.

SIR: Agreeably to your request, I submit herewith estimates of the appropriations necessary for the fiscal year ending June 30, 1878, under the following heads, viz :

For compensation to postmasters .....	\$7, 500, 000
For clerks in post-offices .....	3, 700, 000
For letter-carriers .....	2, 100, 000
For wrapping-paper .....	25, 000
For twine .....	55, 000
For marking and rating stamps .....	10, 000
For letter balances and scales .....	6, 000
For rent, fuel, and light .....	450, 000
For office-furniture .....	30, 000
For stationery .....	55, 000
For miscellaneous and incidental items .....	145, 000
Making in the aggregate .....	14, 076, 000

These estimates are believed to be as low as the requirements of the service will permit, and, in the estimation of this office, leave but a very small margin out of which to provide for the constant demand in all parts of the country for increased postal facilities. In view of the limited appropriations for the present fiscal year, the Department has felt constrained to deny, from the necessities of the case, many extensions of the service which seemed in themselves both proper and reasonable; but the further continuance of this policy is believed to be unwise and detrimental to the best interests of any country whose development in other respects shows such marked and rapid progress as the United States.

Accompanying this is a tabular statement, marked "A," giving more definite information.

Yours, very respectfully,

JAMES H. MARR,  
Acting First Assistant Postmaster-General.

Hon. E. W. BARBER,  
Third Assistant Postmaster-General.

A.—Statement showing the increase or decrease per centum, for the items named below, of the appropriations for the fiscal years ending June 30, 1876, and June 30, 1877, as compared with the estimates for the fiscal year ending June 30, 1878; also the increase or decrease per centum, for the same items, of the expenditures for the fiscal year ending June 30, 1876, as compared with the estimates for the fiscal year ending June 30, 1878.

Items.	Appropriation for the fiscal year ending June 30, 1876.	Estimate for the fiscal year ending June 30, 1878.	Per centum of increase or decrease of estimates for 1877-1878 over appropriation for 1875-1876.		Appropriation for the fiscal year ending June 30, 1877.	Estimate for the fiscal year ending June 30, 1878.	Per centum of increase or decrease of estimate for 1877-1878 over appropriation for 1876-1877.		Expended during the fiscal year ending June 30, 1876.	Per centum of increase or decrease of estimate for 1877-1878 over expenditures for 1875-1876.	
			Increase.	Decrease.			Increase.	Decrease.		Increase.	Decrease.
For compensation to postmasters.....	\$7,000,000	\$7,500,000	7.14		\$7,000,000	\$7,500,000	7.14		\$7,397,397 01	1.38	
For clerks in post-offices.....	3,500,000	3,700,000	5.71		3,280,000	3,700,000	12.46		3,480,730 15	6.29	
For letter-carriers.....	2,000,000	2,100,000	5.00		1,900,000	2,100,000	10.52		1,880,795 03	6.02	
For wrapping-paper.....	25,000	25,000			90,000	25,000	95.00		18,207 02	37.3	
For twine.....	55,000	55,000			50,000	55,000	10.00		38,918 29	15.63	
For marking and rating stamps.....	10,000	10,000			10,000	10,000			8,857 90	12.89	
For letter-balances and scales.....	3,000	6,000	100.00		5,000	6,000	90.00		3,906 39	53.39	
For rent, fuel, and light.....	500,000	450,000		10.00	390,000	450,000	15.30		390,492 77	15.25	
For office furniture.....	35,000	30,000		16.66	90,000	30,000	50.00		19,500 27	53.27	
For stationery.....	50,000	55,000	10.00		50,000	55,000	10.00		43,343 06	24.89	
For miscellaneous and incidental items.....	150,000	145,000		3.44	75,000	145,000	93.33		76,060 46	92.00	
Total.....	13,388,000	14,076,000	5.68		12,810,000	14,076,000	9.87		13,458,168 34	4.59	

POST-OFFICE DEPARTMENT,  
OFFICE OF THE SECOND ASSISTANT POSTMASTER-GENERAL,  
*Washington, D. C., October 27, 1876.*

SIR: At the close of the last fiscal year, June 30, 1876, the annual cost of inland mail transportation was as follows, viz :

On 912 railroad-routes, aggregating 72,348 miles in length.....	\$9, 543, 134
On 88 steamboat-routes, aggregating 14,883 miles in length.....	606, 465
On 8,003 other routes, designated as "star routes," aggregating 194,567 miles in length.....	5, 051, 541
Total cost.....	15, 201, 140

Compared with the state of the service at the close of the preceding year, the railroad-routes showed an increase of 41 in number, of 2,265 miles in aggregate length, and of \$326,616 in annual cost; the steamboat-routes a decrease of 1 in number, of 905 miles in aggregate length, and of \$77,665 in annual cost; and the "star routes" an increase of 680 in number and 2,565 miles in aggregate length, and a decrease of \$402,180 in annual cost. Taken together, the increase in the number of routes was 720, and in the aggregate length 3,925 miles, and the decrease in annual cost \$152,229.

By the act of July 12, 1876, making appropriations for the service of the Post-Office Department for the fiscal year ending June 30, 1877, the Postmaster-General is directed in the first section to reduce the compensation to be paid from and after July 1, 1876, for the transportation of mails on railroad-routes ten per centum from the rates fixed and allowed "on the basis of the average weight" by the first section of the act of March 3, 1873. And the thirteenth section of the act of July 12, 1876, provides "that railroad companies whose railroad was constructed in whole or in part by a land-grant made by Congress on the condition that the mails should be transported over their road at such price as Congress should by law direct shall receive only eighty per centum of the compensation authorized by this act." According to the advice of the law-officers of the Government, the ten per centum reduction is not applicable to the compensation for railroad mail-service performed under contracts made in due form of law, or to allowances for railway post-office cars, mail-messenger service, side service, or ferriage.

As above shown, the annual cost of mail transportation on railroad-routes at the close of the last fiscal year was \$9,543,134. By the re-adjustment of the rates of pay under the act of March 3, 1873, on the basis of new returns of the amount and character of the service, on routes chiefly in States in which a new contract term began with the current fiscal year, the annual cost of the service from July 1, 1876, would have been \$9,757,546. Of this amount the sum of \$2,495,676 is not subject to the ten per cent. reduction ordered by the first section of the act of July 12, 1876, being composed of the items decided by the law-officers to be exempt, as above stated. The amount of the ten per cent. reduction cast on the remaining \$7,261,870, is, therefore, \$726,187.

The amount of pay subject to the reduction required by the thirteenth section of the act of July 12, 1876, is \$1,303,572, composed of the compensation on land-grant roads, whether under contract or otherwise, the law-officers having advised that the contracts did not constitute a ground of exemption from the operation of the thirteenth section. The amount of the reduction under that section, therefore, is \$260,714.

The reductions under the two sections amounting to \$986,901, the cost of the service, after deducting this amount, is, for the first quarter of the current fiscal year, at the rate of \$8,770,645 per annum.

The appropriation made by the act of July 12, 1876, for the year ending June 30, 1877, for transportation by railroad being .....	\$9,100,000
And the present annual cost as reduced under the act...	8,770,645

There remains for new service and for increase of cost by further re-adjustment for the year the sum of..... • 329,355

This state of facts has but just been ascertained, the examination and decision of legal questions raised by the new legislation embodied in the act of July 12, 1876, as well as the numerous and complex calculations which it rendered necessary, having caused delay. The determination to decline establishing new railroad-service, adopted while the means of defraying increased expense were not apparent, may now be relaxed.

Estimates of the amounts of money necessary to be appropriated for inland-mail transportation and items incident thereto for the fiscal year ending June 30, 1878, are presented herewith, in tabular form. Following the form of the appropriation for the present year, separate estimates are made for transportation by railroad and by routes other than railroad. The table shows the cost for 1875 and 1876, and the appropriation for 1877, with the per centum increase and decrease of cost for 1876 compared with that for 1875, and of the appropriation for 1877 compared with the cost for 1876. The increase of the cost of railroad transportation for 1876 over 1875 is 3.54 per cent.; and the decrease of the appropriation for the same purpose for 1877, compared with the cost for 1876, is 4.64 per cent. The cost for 1877, at the rate of increase for 1876 over 1875, 3.54 per cent., apart from the reductions ordered by act of July 12, 1876, would be \$9,880,960. The estimate for 1878 is set down, at the same rate of increase, at \$10,230,745, the reductions ordered by the recent act being regarded as temporary, inasmuch as the act itself authorizes the appointment of a commission to "examine into the subject of transportation of the mails by railroad companies and report to Congress at the commencement of its next session such rules and regulations for such transportation and rates of compensation therefor as shall in their opinion be just and expedient, and enable the Department to fulfill the required and necessary service for the public."

The cost of transportation on other than railroad-routes for 1876 was \$5,658,006. Estimating the cost for 1877 at an increase of 5 per cent., the amount would be \$5,940,946. At the same rate of increase, the estimate for 1878 is set down at \$6,237,993. This is deemed sufficient for the probable requirements of the service, though the sum is \$499,858 less than the appropriation for the current year.

Uniting the amounts named for railroad routes, \$10,230,745, and for routes other than railroad, \$6,237,993, the aggregate estimate for inland transportation for 1878 is \$16,468,738, less, by \$1,079,262, than the amount appropriated for 1876 and estimated for 1877, which was \$17,548,000, and only \$630,887 more than the appropriation for the two items for the current year, \$9,100,000 for railroad and \$6,737,851 for other routes, making together \$15,837,851.

The estimate for 1878 for railway post-office clerks is \$1,355,040; for route-agents, \$1,071,000; for mail-route messengers, \$161,175; and for local agents, \$114,450. For a statement of the considerations which

have led to the presentation of these figures, I beg leave to refer to the accompanying letter from the general superintendent of railway mail service.

The estimate for mail-messenger service for 1878 is put at \$704,025, an increase of 5 per cent. on the appropriation for the current year, which it is anticipated the natural growth of the service will require. The increase of the cost for 1876 over 1875 was 5.54 per cent.

The estimate for mail locks and keys for 1878 is \$20,000, the amount appropriated for the current year. And for mail-bags and mail-bag catchers the estimate for 1878 is \$225,000, an excess of \$50,000 over the appropriation for the current year. That appropriation is \$25,000 less than the estimate made by the Department for the year, and will, it is believed, fall short by that amount of meeting the actual needs of the service, rendering necessary for the next year the increased amount here stated.

By reference to Table G, prepared for the appendix to your annual report, it will be seen that the total number of new mail-bags purchased and put into the service during the year 1876 was 103,794, of which 22,814 were locked pouches and bags, used chiefly for letters, and 80,980 tied sacks, (canvas,) used exclusively for printed and third-class matter. This was an increase over the preceding year of 10,264 locked pouches and bags and 13,314 tied sacks. This increase was largely occasioned by the extension of service on railway-routes, the increased frequency and expedition of the mails, the establishment of the through registered-mail system, and the increased bulk of printed and third-class mail-matter. The growth of the railway mail-service will continue to increase this item of expense to the Department. But while the expenditure for new mail-bags was thus increased, there was an extraordinary decrease of the aggregate cost of repairs, caused by a radical reform in the method of having such work done. Under a practice which was established by postal regulation, and which had prevailed for more than thirty years, damaged mail-bags, collected in nearly all the principal cities, were given out from the post-offices for repairs by special contract. The aggregate cost under that system, however inconsiderable for a time after its inception, gradually increased with the growth of the mail-service until at length it assumed such magnitude as to call for investigation and correction. This investigation was made by yourself while at the head of this bureau, and the plan now in operation devised. This system abolishes entirely the old contract system, and concentrates all the damaged mail-bags at the several depositories in the post-offices at New York, Washington, Indianapolis, Saint Louis, and Chicago. In these post-offices repair-shops are established, and the needful operatives are employed by the postmasters at fixed wages to repair, under the supervision of skilled foremen, all the mail-bags of every description requiring repairs. The material of bags too old and damaged for judicious repairs is utilized to such an extent that small outlays are required for new material. The cost of tools is also comparatively small. Under this system the total cost of such repairs during the year was only \$30,161.92. During the preceding year, under the old system, the cost of repairs was \$92,419.95.

Tables herewith show the contracts in operation on the 30th June, 1876, for mail-bags, mail-bag catchers, and mail locks and keys, with the name and residence of each contractor, the term of contract, and the price paid for each article of every size and kind.

The increased appropriation asked for in the item of mail-bags and mail-bag catchers is due to the probable increase in the railway mail-



service. New lines of railway are completed and approaching completion, and each one largely increases the number of mail-bags and catchers necessary to conduct the service.

The aggregate estimate for 1878 for inland transportation and the items incident thereto will be found to be \$20,119,428, against an appropriation for the current year of \$19,163,351—an increase of only \$956,077, or a little under 5 per cent.

I have the honor to be, sir, very respectfully, your obedient servant,

THOS. J. BRADY,

*Second Assistant Postmaster-General.*

Hon. JAMES N. TYNER,

*Postmaster-General.*

## REPORT OF THE POSTMASTER-GENERAL.

*Statement of all contracts in operation the 30th June, 1876, for mail-bags, mail-catchers, mail-bag labels, and mail-bag-label cases.*

Articles contracted for.	Names of contractors.	Residence.	Term of contract.		Prices paid.				
			From—	To—	Size No. 1.	Size No. 2.	Size No. 3.	Size No. 4.	Size No. 5.
Jute canvas mail-sacks.....	John Boyle.....	New York, N. Y.....	July 1, 1875	July 1, 1879	\$0 66	\$0 52	\$0 15	.....	.....
Cotton canvas mail-sacks.....	do.....	do.....	July 1, 1875	July 1, 1879	1 32	1 02	21	.....	.....
Leather horse-mail bags.....	Polydore S. Thomson.....	do.....	July 1, 1875	July 1, 1879	6 60	5 60	5 10	.....	.....
Mail-catcher pouches.....	John Boyle.....	do.....	July 1, 1875	July 1, 1879	.....	4 25	.....	.....	.....
Mail-bag-label cases.....	Gaylord Manufacturing Company.....	Chilcopee, Mass.....	July 1, 1875	July 1, 1879	.....	12	.....	.....	.....
Leather mail-pouches.....	J. C. Feltman.....	Albany, N. Y.....	July 1, 1875	July 1, 1879	6 50	5 70	4 75	\$3 80	\$2 70
Use of patent for leather pouches.....	John Boyle, (patentee).....	New York, N. Y.....	Nov. 20, 1875	Aug. 7, 1876	6 10	10	10	10	10
Printed wooden labels.....	William P. Wood.....	Washington, D. C.....	Dec. 1, 1875	Dec. 1, 1876	.....	.....	15 00	.....	.....
Mail-bag catchers.....	Abbott, Brew & Co.....	Cleveland, Ohio.....	.....	.....	.....	.....	.....	.....	.....
Mail-bag-catcher sockets.....	do.....	do.....	.....	.....	70	40	.....	.....	.....

\* Until aggregate sum of payments amount to \$10,000, when any further payment will cease for use of patent.

THOMAS J. BRADY,  
Second Assistant Postmaster-General.

*Statement of all contracts in operation the 30th June, 1876, for mail locks and keys.*

Articles contracted for.	Names of contractors.	Residence.	Term of contract.		Prices paid.	
			From—	To—	Locks.	Keys.
Registered mail locks and keys.....	F. W. Mix.....	Terryville, Conn.....	Jan. 1, 1874	Jan. 1, 1878	\$1 75	\$0 30
Letter-box locks and keys.....	Smith & Edge.....	Bridgeport, Conn.....	Jan. 1, 1874	Jan. 1, 1878	1 25	15
Mail-bag locks and keys.....	James C. Mix.....	Syracuse, N. Y.....	July 1, 1874	July 1, 1878	74	13

THOMAS J. BRADY,  
Second Assistant Postmaster-General.

*Cost of inland transportation and the items incident thereto for the years 1875 and 1876, with the appropriation for 1877, and the estimates of the amounts necessary to be appropriated for 1878; showing the percentage of increase and decrease, with the cost, appropriation, and estimate for mail locks and keys, mail-bags, and mail-bag catchers.*

Object.	Cost for 1875.	Cost for 1876.	Per centum increase or decrease of 1876 as to 1875.		Appropriation for 1877.	Per centum increase or decrease of appropriation of 1877 as to cost of 1876.		Estimate for 1878.	Per centum increase or decrease as to appropriation for 1877.	
			Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.
Inland transportation, railroad.....	\$9,216,518 00	\$9,543,134 00	3.54	.....	\$9,100,000 00	.....	.....	\$10,230,745 00	12.43	.....
Inland transportation, other than railroad.....	6,136,851 00	5,658,005 00	.....	7.80	6,737,851 00	19.00	.....	6,237,953 00	.....	7.42
Railway post-office clerks.....	1,522,640 00	1,278,340 00	13.87	.....	1,525,000 00	.....	4.17	1,355,040 00	10.61	.....
Route-agents.....	943,800 00	975,290 00	3.33	.....	978,500 00	.....	0.20	1,071,000 00	10.13	.....
Mail-route messengers.....	147,470 00	145,610 00	.....	1.26	153,500 00	5.42	.....	161,175 00	5.00	.....
Local agents.....	96,580 00	104,910 00	8.62	.....	109,000 00	3.69	.....	114,450 00	5.00	.....
Mail-messengers.....	621,311 42	655,768 00	5.54	.....	670,500 00	2.94	.....	704,025 00	5.00	.....
Mail locks and keys.....	31,811 42	16,720 95	.....	47.43	80,000 00	19.60	.....	20,000 00	.....	.....
Mail-bags and mail-bag catchers.....	187,148 08	208,847 49	11.59	.....	175,000 00	.....	16.31	225,000 00	28.57	.....
	.....	.....	.....	.....	19,163,351 00	.....	.....	20,119,428 00	4.99	.....

The increase in the cost of mail locks and keys in 1875 is owing to putting on mail-locks on street letter-boxes.

THOMAS J. BRADY,  
Second Assistant Postmaster-General.

POST-OFFICE DEPARTMENT,  
OFFICE OF THIRD ASSISTANT POSTMASTER-GENERAL,  
*Washington, D. C., November 11, 1876.*

SIR: Herewith I have the honor to submit the following tables:

1. Estimate of the expenditures and revenues of the Post-Office Department for the fiscal year ending June 30, 1878.
2. Estimate of the indebtedness of the Department for the past two fiscal years, not yet adjusted.
3. Receipts and expenditures for the fiscal year ended June 30, 1876, compared with the two preceding years.
4. Receipts and disbursements on account of the Post-Office Department at Treasury depositories.
5. Receipts and disbursements at Post-Office depositories.
- 6 and 7. Number and value of postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the year.
8. Number and value of official postage-stamps, stamped envelopes, and wrappers furnished the different Executive Departments during the year.
9. Statement showing increase in issues of postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards, of all kinds.
10. Number and value of dead letters received and disposed of at Dead-Letter Office during the year.
11. Statement showing classification and disposition of letters containing valuable inclosures received at Dead-Letter Office during the year.
12. Statement showing number, contents, and disposition of registered letters received at Dead-Letter Office during the year.
13. Number of registered letters sent through the mails, with amount of fees collected thereon, in each State and Territory during the year.

**EXPLANATION OF ESTIMATES.**

Your attention is respectfully invited to the following detailed statement touching the appropriations asked for by this bureau:

**ADHESIVE POSTAGE-STAMPS.**

The number of ordinary postage-stamps issued during the fiscal year ended June 30, 1876, was.....	698,799,090
Add 10 per cent., being about the average yearly rate of increase.....	69,879,909
<hr/>	
Gives estimated issue of ordinary stamps for fiscal year ending June 30, 1877.....	768,678,999
Add 10 per cent., as before.....	76,867,899
<hr/>	
Gives estimated issue of ordinary stamps for fiscal year ending June 30, 1878.....	845,546,898
<hr/>	
Cost of manufacturing that number at present contract price, 14.99 cents per thousand.....	\$126,747 48
Add estimated cost of manufacturing official stamps, and also of manufacturing the newspaper and periodical stamps required by act of Congress approved June 23, 1874.....	24,000 00
<hr/>	
Gives estimated total cost of manufacturing adhesive postage-stamps during fiscal year ending June 30, 1878.....	150,747 48

In the foregoing estimate the issues of ordinary stamps, the average annual rate of increase, and the present contract rates, are taken as the best basis of calculation to be obtained.

It is not expected that there will be a great increase, if any, in the

issues of official stamps and newspaper and periodical stamps, and accordingly the estimate is fixed at the same amount (\$24,000) as in the appropriation for the current fiscal year. The contracts for manufacturing stamps will expire on the 1st May, 1877, but under a new contract there will not probably be any material deviation from present rates.

#### POSTAGE-STAMP AGENCY.

For pay of agent and assistants to distribute stamps, and expenses of the agency.. \$8, 100

This estimate exceeds the present appropriation by \$1,200, which amount is intended for the employment of an additional clerk. During the past three years the number of requisitions for postage-stamps has increased more than 57 per cent., reaching 150,284 during the last fiscal year, from 95,377 during the fiscal year ending June 30, 1873; and additional clerical assistance has become absolutely essential to the proper discharge of the business of the agency. The present force consists of an agent at a salary of \$2,500 per annum, and two clerks at salaries of \$1,800 and \$1,600, respectively.

The item "for expenses of agency" is for the purchase of stationery and furniture, and for the necessary expenses of officers and agents while employed in inspecting the manufactory and making investigations connected with the issue of postage-stamps. The amount included for these purposes (\$1,000) is the same as in the present appropriation, no increase being deemed necessary.

#### ORDINARY AND OFFICIAL STAMPED ENVELOPES AND WRAPPERS.

The cost of stamped envelopes and newspaper-wrappers, both ordinary and official, issued during the year ended June 30, 1876, at present contract prices, was .....	\$428, 219 03
Add 20 per cent. for increase.....	85, 643 80
Gives estimated cost for year ending June 30, 1877.....	513, 862 83
Add 20 per cent. for increase, as before.....	102, 772 56
Gives estimated cost of manufacture for the year ending June 30, 1878...	616, 635 39

The same bases of calculation are taken as in the case of postage-stamps, but owing to the greater popularity of stamped envelopes and wrappers, a much larger rate of increase in the issues is to be expected. The issues for the six months ending June 30, 1876, were nearly 17 per cent. in excess of those for the corresponding period of the previous year, and an estimated future increase of 20 per cent. is not an extravagant one. The existing contract is for four years, expiring September 30, 1878, and the rates will therefore remain unchanged.

The stamped envelopes and newspaper-wrappers issued during the fiscal year ending June 30, 1876, were sold at an excess of \$40,382.08 over the postage value and the cost of manufacture. Adhesive postage-stamps being sold at face value, the public are not required to pay the cost of manufacture, as in the case of stamped envelopes.

#### STAMPED-ENVELOPE AGENCY.

For pay of agent and assistants to distribute stamped envelopes and newspaper-wrappers, and expenses of agency..... \$16, 300

This estimate agrees in amount with the present appropriation. In explanation of the apparently large amount required for this agency as compared with the New York agency, it may be stated that owing to its near proximity to the railroad depot, the envelopes and wrappers are

mailed directly from the manufactory, instead of going through the Hartford post-office, which is located at a considerable distance from the depot. A large portion of the appropriation is therefore required for the payment of clerks engaged in the registration of packages, which is properly to be considered as post-office work. The postage-stamps are mailed from the New York post-office, where the work of registration is done.

The only salaries in excess of \$1,200 per annum paid at the Hartford agency are those of the agent who receives \$2,500, and of the two principal clerks of the agency proper and of the registry branch, who receive \$1,800 each.

The amount included for "expenses of agency" is \$1,000, the same as in the appropriation for the present year. It is required for the same general purposes as in the case of the stamp agency.

#### POSTAL CARDS.

Number of postal cards issued during the fiscal year ended June 30, 1876.	150,815,000
Add 20 per cent. for increase .....	30,163,000
Gives estimated issue for the year ending June 30, 1877 .....	180,978,000
Add 20 per cent. for increase, as before .....	36,195,600
Gives estimated issue for the year ending June 30, 1878.....	217,173,600
Cost of manufacturing that number at present contract prices, \$1.39½ per thousand.....	\$303,771 56

The increase in the issue of postal cards for the last fiscal year over the preceding one was a little over 40 per cent., but it is not expected to continue at this extraordinary rate. It was undoubtedly due in a great measure to special demands growing out of the Centennial Exhibition, for advertising purposes, and for the correspondence of the unusually large number of people in transit during that occasion. A future increase of 20 per cent. per annum is considered a fair one, and accordingly taken in the above estimate. That it is not extravagant is shown by the fact that the increase for the fiscal year ending June 30, 1875, over the previous year was more than 18 per cent.

The present contract will expire on the 1st May, 1877, but no great variation in price under a new one is anticipated.

#### POSTAL-CARD AGENCY.

For pay of agent and assistants to distribute postal cards, and expenses of agency .....	\$7,300
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At present there are employed at Springfield, Mass., in connection with the inspection and distribution of postal cards, an agent, at a salary of \$2,500 per annum, and two clerks, one at \$1,400 and the other at \$1,200 per annum.

The present appropriation for the agency is \$6,100, and the foregoing estimate contemplates the employment of an additional clerk at an annual salary of \$1,200.

The number of requisitions for postal cards filled during the fiscal year ending June 30, 1876, was 43,103, and for the fiscal year ending June 30, 1874, 23,634—an increase of 19,469, or a little more than 82 per cent. While, therefore, the work of the agency has nearly doubled within the past two years, no increase of the clerical force has been granted during that time.

The necessity for an additional clerk will be apparent upon this statement of facts. It is certain that the increased business of the future cannot be properly done by the present force, which is now barely adequate.

Postal-card packages are registered and mailed directly from the agency, and not from the Springfield post-office, in like manner as stamped envelopes from the Hartford agency, and for the same reasons.

The estimate, like those for the New York and Hartford agencies, and with similar objects in view, contains an item of \$1,000 for expenses, agreeing in that particular with the appropriation for the current year.

#### REGISTERED-PACKAGE ENVELOPES, LOCKS, AND SEALS.

For registered-package envelopes, locks, and seals. .... \$40,000

The foregoing estimate is for the same amount as in the appropriation for the current year. The amount expended for these purposes during the fiscal year ending June 30, 1876, was \$37,159.01; and, considering the natural increase of the registry business, the estimate will not appear unreasonable.

#### POST-OFFICE AND DEAD-LETTER ENVELOPES.

For post-office and dead-letter envelopes. .... \$42,150

In the above estimate, post-office and dead-letter envelopes, now appropriated for separately, are taken together, for the reason that both kinds are furnished under the same contract, and because the dead-letter envelope is really of the same size and grade as one of the items in the series of post-office envelopes. The amount appropriated for post-office envelopes for the present fiscal year is \$40,000, and for dead-letter envelopes, \$2,150; and the estimate, being for the aggregate of these two amounts, shows no increase over present appropriations. The contract for these envelopes, like that for registered-package envelopes, is, by law, let for one year only, and present rates, therefore, are no absolute criterion for the future.

Post-office envelopes are plain (unstamped) envelopes used in post-offices for official business, and dead-letter envelopes are used for returning dead letters to writers.

#### SHIP, STEAMBOAT, AND WAY LETTERS.

Sections 3913, 3976, 3977, and 3978, of the Revised Statutes make this appropriation necessary to provide for the payment, to masters or owners of vessels not regularly engaged in transporting the mails, for letters brought and delivered at the post-office, on arrival in port, for transmission to their destination. On delivery of these letters the party addressed pays, in addition to the usual postage, the amount paid to the said masters or owners; consequently, the amounts paid out come back to the Department.

The amount required for this purpose for the next fiscal year is \$7,500.

#### ENGRAVING, PRINTING, AND BINDING DRAFTS AND WARRANTS.

Under this head the Department is supplied with its drafts and warrants used in paying contractors and other creditors, and for the collection of a portion of the balances due the United States by postmasters.

The amount which will be required for this purpose during the next fiscal year is estimated to be \$1,500.

#### SUMMARY OF ESTIMATES.

The amounts estimated to be required by this bureau for service of the fiscal year ending June 30, 1878, as compared with appropriations for 1876-'77, are shown by the following table :

Items.	Appropriated for 1876-'77.	Estimate for 1877-'78.
Postage-stamps .....	\$147,762	\$150,747
Expenses of agency .....	6,900	8,100
Stamped envelopes and wrappers .....	535,878	616,635
Expenses of agency .....	16,300	16,300
Postal cards .....	216,760	303,771
Expenses of agency .....	6,100	7,300
Registered-package envelopes, &c .....	40,000	40,000
Post-office and dead-letter envelopes .....	42,150	42,150
Ship, steamboat, and way letters .....	7,500	7,500
Engraving and printing drafts and warrants .....	1,500	1,500
Total .....	1,020,850	1,194,003
Increase of estimates, (nearly 17 per cent.) .....		1,020,850
		173,153

#### OPERATIONS OF THE BUREAU.

The operations of this bureau, through its different divisions, are fully set forth by the following detailed statements :

#### DIVISION OF FINANCE.

During the fiscal year ended June 30, 1876, there were furnished to this division 3,811 contracts for mail-service, for record upon its books, and 8,312 orders of the Postmaster-General (an increase of 2,304 over last year) recognizing mail-service not under contract, extending or curtailing service, or for the modification of previous orders, which were also recorded.

These contracts and orders furnish complete data by which to insure correct payments to mail-contractors, and consequently make this division a perfect check on the other offices that pass upon contractors' accounts.

Thirty-two thousand eight hundred and fifty (32,850) Auditor's reports (an increase of 2,414 over last year) for pay of mail-contractors and other creditors of the Department, were received, verified, recorded, and paid.

Cash accounts of receipts and disbursements were kept with 45 Treasury depositories, from which were received 980 transcripts of accounts, involving the sum of \$10,552,842.81, against which sum there were drawn, registered, and posted to the proper accounts, 13,456 warrants, (an increase of 1,178 over last year.)

These warrants, each accompanied by a circular-receipt, were mailed to the payees, and the receipts, when returned, entered upon the books to show the delivery of the warrants.



(Table No. 4, attached to this report, shows the cash transactions at Treasury depositories in detail.)

To facilitate the business of the Department, the number of Post-Office depositories was reduced during the year from 128 to 100, at which the receipts and disbursements involved the sum of \$3,307,244.87, divided as follows: Receipts from proceeds of the depositories themselves, \$2,784,217.08; from collection drafts on other offices, \$163,737.10; and from deposits by other offices, \$359,290.69. Against the aggregate accumulation in the depositories, there were drawn and posted to the legitimate accounts 19,446 drafts, (an increase of 1,188 over last year.) In addition to the amount paid out upon drafts, (\$1,594,066.76,) the sum of \$1,647,779.70 was paid to route-agents, postal clerks, mail-messengers, letter-carriers, &c., which sum entered into the accounts kept with the depositories.

The number of statements of account received from the postmasters at these 100 depositories during the year was 1,200.

(Table No. 5 of this report shows the cash transactions at Post-Office depositories in detail.)

The number of depositing offices averaged during the year 2,900, standing on June 30, 1876, at 2,683, from which offices there were received 8,905 certificates of deposit, amounting in the aggregate to \$5,192,681.43, which amount was duly credited to the postmasters making the deposits.

The number of circulars sent out during the year was 19,250; the number of quarterly statements of account furnished to postmasters was 1,775; and the number of letters received and acted upon in the transaction of the business of the division, together with those written, exceeded 2,500.

As shown by the foregoing, there has been a general increase in the work of this division, and, in the natural course of events, it will continue to increase in the future at about the same ratio.

The present force, therefore, should suffer no diminution, but, on the contrary, should be increased as the necessities of the division require.

#### DIVISION OF POSTAGE-STAMPS, ENVELOPES, AND POSTAL CARDS.

The number of ordinary adhesive postage-stamps issued to postmasters for sale to the public during the year was 698,799,090, valued at \$18,773,454; of newspaper and periodical stamps, 1,290,347, valued at \$945,254.75; of ordinary stamped envelopes, plain, 82,467,000, valued at \$2,280,318.74; of stamped envelopes bearing a return-request, 64,554,500, valued at \$2,079,578.30; of newspaper-wrappers, 18,498,750, valued at \$273,723.50; of postal cards, 150,815,000, valued at \$1,508,150; of official postage-stamps issued to the Executive Departments for official use, 17,682,665, valued at \$663,831.50; and of official stamped envelopes and wrappers, 15,690,155, valued at \$429,110.93; making a total number of 1,049,797,507, and a total value of \$26,963,421.72. The increase in value of ordinary postage-stamps was \$501,975, or 2.74 per cent.; of newspaper and periodical stamps, \$129,352.28, or 15.85 per cent.; of ordinary stamped envelopes, plain, \$234,207.39, or 11.44 per cent.; of special-request stamped envelopes, \$287,892.05, or 16.06 per cent.; of postal cards, \$431,990, or 40.14 per cent.; and of official stamped envelopes and wrappers, \$74,588.75, or 21.03 per cent.

There was a decrease of \$12,956.24, or 4.50 per cent., in ordinary newspaper-wrappers, and of \$171,138.75, or 20.49 per cent., in official postage-stamps.

To sum up, the net increase in the value of ordinary issues was \$1,572,460.48, or 6.47 per cent.

The increase, including the issues for official use, was \$1,475,910.48, or 5.79 per cent.

There were also issued within the year 4,025,450 registered-package envelopes, 8,673,975 post-office envelopes, and 1,572,000 dead-letter envelopes; total, 14,271,425.

The number of requisitions filled was as follows: For ordinary postage-stamps, 104,037; for newspaper and periodical stamps, 7,212; for official postage-stamps, 39,035; for ordinary stamped envelopes and wrappers, plain, 49,969; for special-request stamped envelopes, 66,190; for official stamped envelopes, 3,059; for postal cards, 43,103; for registered-package envelopes, 41,640; and for post-office envelopes, 39,865.

The increase in the number of requisitions filled during the last over the previous fiscal year, for ordinary postage-stamps, was 6,865, or 7 per cent.; for newspaper and periodical stamps, 2,040, or 39.4 per cent.; for ordinary stamped envelopes and wrappers, plain, 6,296, or 14.4 per cent.; for special-request stamped envelopes, 12,950, or 24.3 per cent.; for official stamped envelopes, 130, or 4.4 per cent.; for postal cards, 12,135, or 39.1 per cent.; for registered-package envelopes, 5,170, or 14.1 per cent.; and for post-office envelopes, 3,940, or 10.9 per cent.

There was a decrease of 222 in the number of requisitions for official postage-stamps.

The total number of requisitions filled was 394,110, a net increase of 49,304, or 14.2 per cent.

The number of packages of ordinary postage-stamps forwarded was 105,343, an increase of 6,695, or 6.78 per cent.; of newspaper and periodical stamps, 7,093, an increase of 1,920, or 37.11 per cent.; of ordinary stamped envelopes and wrappers, 69,019, an increase of 6,920, or 11.11 per cent.; of stamped envelopes bearing a return-request, 51,500, an increase of 9,301, or 22.04 per cent.; of postal cards, 53,231, an increase of 20,600, or 63.13 per cent.; of official postage-stamps, 38,711, an increase of 101, or 2.6 per cent.; of official stamped envelopes and wrappers, 6,886, an increase of 446, or 6.92 per cent.; of registered-package envelopes, 42,440, an increase of 5,210, or 13.99 per cent.; and of post-office envelopes, 40,436, an increase of 4,004, or 19.99 per cent.

The losses in transit during the year were unusually small, consisting of four packages of postage-stamps, valued at \$129; one package of stamped envelopes, valued at \$8.45; and two packages of postal cards, valued at \$10. This trifling loss of only seven packages, valued at \$147.45, out of 331,783 packages, representing an aggregate value of \$26,953,421.72, furnishes an excellent illustration of the reliability of the registry system as a means of conveyance for valuable matter.

Under the act of Congress approved June 23, 1874, to take effect January 1, 1875, requiring prepayment of postage on newspapers and periodical publications mailed from known offices of publication or news-agencies to regular subscribers or news-agents, the amount of postage collected during the fiscal year was \$1,014,151.27, or \$788,891.98 on 39,444,599 pounds of matter at 2 cents per pound, and \$225,262.29 on 7,508,743 pounds at 3 cents per pound. The amount collected during the six months ending June 30, 1875, was \$486,443.49, and the increase is therefore at the rate of \$41,267.29, or 4.24 per cent. per annum.

The New York office alone, during the year, mailed 12,724,015 pounds at 2 cents per pound, and 3,113,842 pounds at 3 cents per pound, a total of 15,837,857 pounds and of \$347,895.56, and an increase at the rate of \$12,286.24, or 3.66 per cent., per annum.

The system of prepayment of second-class matter has given such general satisfaction, and is so manifestly the true one, that no change in the present law is recommended.

During the past two years considerable attention has been given to the examination of mechanical devices and so-called indelible inks intended for the better cancellation of postage-stamps, so as to prevent their reuse, but without satisfactory results. The truth is, that the only means of preventing frauds in the use of washed stamps lies in the exclusive use of stamped envelopes, which, I am satisfied, would result in an annual saving to the postal revenues of from \$1,000,000 to \$2,000,000.

No changes in the series of postage-stamps or stamped envelopes have been made during the year, except the addition of the No. 4½ commercial size stamped envelope, to which reference was made in my report of last year, and of centennial envelopes, to be alluded to presently.

The commercial envelopes have fully justified the expectation formed of them, the number issued during the year being 17,651,750, or a little more than 12 per cent. of the entire number of envelopes issued. In popularity this size already ranks next to the full-letter and extra-letter sizes, and the indications are that it will take the lead of both of these.

The style of paper and design of postal cards were changed about the 1st of October of last year, with what results will be shown in the increased issues.

To illustrate the process of manufacturing stamped envelopes, the contractors at Hartford early in the year proposed to put one of their improved envelope-machines in the space devoted to the Post-Office Department in the Government building on the Centennial grounds at Philadelphia, and keep it in operation during the continuance of the exhibition without expense to the Department. The proposition was accepted, and a machine, handsomely ornamented, was in almost constant operation, during exhibition hours, from the opening on the 10th May to the 10th November. This machine, with the exception of cutting the blanks or patterns, performs the entire operation of manufacture, folding, stamping, gumming, and, if desired, printing a return-request. Attached to it is an automatic counter, separating the envelopes into packages of 25.

To specially distinguish these envelopes there was adopted for them an entirely new and appropriate design of stamp in the form of a shield inclosing mounted post-boy, train of cars, and telegraph-pole and wires as the principal figures. The paper used has its own distinctive watermark.

These envelopes are styled centennial stamped envelopes. They are of two sizes, No. 3 full letter, and No. 4½ commercial; of but one grade of paper, first quality, white; and of but one denomination, 3 cents.

The design is the same on both sizes of envelopes, the only difference being that the full-letter size are printed in green and the commercial in vermilion.

It was at first intended to confine the issue of these envelopes to the post-office at Philadelphia, but there was immediately such a general demand for them that the privilege of obtaining them was extended to every post-office in the country.

The issues consisted of 4,775,000 of the full-letter size and 4,227,000 of the commercial size, a total of 9,002,000, of which 5,201,250 were plain and 3,800,750 printed with special return-requests.

The centennial envelopes were furnished by the contractors at the same prices as the corresponding sizes and grades of the ordinary series, and sold to the public at the ordinary rates.

Their issue was discontinued on the 10th November, when the exhibition closed; but those outstanding will of course continue to be valid for postages.

As was expected, the envelope-machine proved to be one of the most attractive features of the Government exhibit, if not of the entire exhibition, being constantly surrounded by large crowds of people while at work. That it had a good effect in encouraging the sale of stamped envelopes is shown by the fact that during five consecutive days in August, when the machine was idle through the illness of one of the operatives, the sales of envelopes at the centennial branch post-office fell down to an average of \$30 per day from a daily average of \$150 for the five days immediately preceding.

There is reason to believe that many of the envelopes were purchased as souvenirs, and will never be used for postages.

Another interesting feature of the post-office exhibit at the Centennial was a handsomely framed collection of specimens of all the postage-stamps and stamped envelopes ever issued by the Department.

The operations of the stamp division are, in their very nature, of the highest importance, nearly the whole revenue of the Department being derived from postage-stamps, stamped envelopes, and postal cards.

The issues during the last fiscal year represented a value of nearly \$27,000,000, and the expenditures for material were upwards of 1,000,000.

To properly conduct the work of the division requires the greatest care and fidelity, to the exercise of which I am glad to be able to bear the most flattering testimony. As the principal business of the division consists in filling requisitions, so the increase in the number of requisitions may be accepted as a criterion of the increase of work. There is, of course, much incidental work in conducting the necessary correspondence, in the preparation of permanent records, the auditing of postmasters' returns of official stamps and envelopes, the adjustment of damaged and unsalable stock returned, and of losses by fire and in the mails, and in other details not necessary to be specified, all of which work increases with the number of requisitions handled.

As before stated, the total number of requisitions filled during the last fiscal year was 394,110, or an increase at the rate of 14.2 per cent. over the previous year. The increase over the fiscal year ending June 30, 1873, was 184,874, or a little over 88 per cent., so that the requisitions have nearly doubled within a period of three years. During this time the increase of clerical force has not kept pace with the increase of work; and, indeed, the division has recently suffered a slight decrease in numbers in contributing its quota to the reductions occasioned by Congress at its last session—a diminution that it was but ill able to sustain.

The work is now carried on only through extraordinary effort; and it is very certain that additional help will be necessary to properly conduct it in the future, and equally certain that it would be mistaken economy to withhold any of the force required for work of this character.

#### DIVISION OF DEAD-LETTERS.

The number and description of letters received and disposed of in this division during the year, and the value and character of the contents, are fully shown by tables Nos. 10, 11, and 12, submitted herewith for your consideration.

The reduction in the number of letters received is explained by the

facts, 1st, that the use of envelopes bearing requests or business cards is becoming more general, and thus postmasters are enabled to return an increased number of unclaimed letters direct to the writers; 2d, the increased efficiency of the letter-carrier service in large cities; and, 3d, the action of this office in calling the attention of postmasters to cases of mistreatment of correspondence, and thereby providing against a repetition of the error. The present manner of treating held-for-postage letters, which was introduced in April, 1875, and referred to in my last report, viz, holding them in the dead-letter office unopened, and requesting the addressees to furnish the necessary postage, has proven a success in this, that the Department now receives its revenue upon this class of letters, and yet does not encourage the non-payment of postage by the writers, the delay in delivery being a sufficient hardship to incite greater precaution in posting letters. Of the 307,559 held-for-postage letters received, 20,255 were either also misdirected or addressed to foreign countries to which prepayment of postage is imperative, and hence were opened and returned to the writers; 278,357 were treated with notice to addressees, and of these 203,203 were successfully delivered unopened; the balance, 68,201, were finally opened, after having been held the usual period subject to the order of the addressees. There is, of course, some complaint made to the office against this plan, and it is not surprising, for most persons who receive notice of the detention of these letters would be glad to have them promptly forwarded and pay the deficient postage on delivery, and hence cannot see the propriety of the delay imposed by the Department. But the system has proven to be less objectionable to the public than the former one, and is believed to be the best that can be devised under the present law requiring prepayment of at least one full rate on all letters mailed. The apparent material reduction in the value of letters received during the year is explained by the fact that so many of these unpaid letters, which are always proportionately more valuable than any other class, were not opened during the year. Every thing of value is restored to the sender, if possible; and in case of valuable letters, the proportion of those delivered is very large; but of packages of third-class matter, upon which the sender is not allowed to write his name, the proportion delivered is much less. An effort has been made, however, to discover some clue to the owners, and with such success that of 8,577 articles sold at auction in January last, but one has subsequently been applied for, and that was a registered package. The present law, passed since the close of the year, allowing the senders of third-class matter to write their names upon the wrappers, will make the return of such matter much more feasible.

I would repeat my recommendation of last year, that some means be adopted for ascertaining approximately the number of letters mailed in the United States annually. Not only would this information add greatly to the value of the statistics of the Department, but furnish a means of contrasting the number delivered with those lost, and thus serve to silence the few irritable persons who stand ready to condemn the whole Post-Office establishment whenever a single letter fails to reach its destination with the usual dispatch, no matter whether the writer deposited it in a street letter-box or the town pump.\*

The whole number of applications made to this office for missing let-

\* Recently some workmen, in removing an old pump in this city, found the stock stuffed with all sorts of rubbish, and among other things several letters; the pump with its slot, from which the handle had long since been removed, having been mistaken for a street letter-box.

ters during the year was 8,405, and in 2,975 of these cases the search was successful.

The amount of money taken from letters which could not be restored to the owner was \$6,052.53. Amount realized from sale of Dead-Letter Office property at auction in January last, \$2,853.17.

#### DIVISION OF REGISTERED LETTERS.

For the first time in the history of the registered-letter system this office presents a detailed statement of its operations. Table No. 13, accompanying this report, shows the number of domestic and foreign letters registered in each State and Territory, together with the fees received thereon, for the fiscal year ended June 30, 1876.

Four million seven thousand eight hundred and seventeen letters were registered during the year, and the fees received thereon amounted to \$335,416.60. An analysis of this gratifying aggregate shows that of the letters registered upon which fees were paid 3,198,931 were domestic; 155,235 were sent to foreign countries; and 653,651 were transmitted through the mails without payment of the registry fee. All the packages of postage-stamps, stamped envelopes, and postal cards sent by the Department to postmasters are included in the free list.

The following statement exhibits the number of letters registered in each State and Territory during the year, viz :

Alabama .....	41, 110	New York .....	602, 499
Arkansas .....	33, 085	North Carolina .....	72, 542
California .....	100, 954	Ohio .....	230, 256
Colorado .....	28, 629	Oregon .....	18, 476
Connecticut .....	176, 101	Pennsylvania .....	274, 940
Delaware .....	6, 211	Rhode Island .....	17, 302
Florida .....	21, 725	South Carolina .....	36, 056
Georgia .....	59, 939	Tennessee .....	61, 195
Illinois .....	263, 934	Texas .....	86, 807
Indiana .....	150, 673	Vermont .....	51, 701
Iowa .....	168, 625	Virginia .....	70, 177
Kansas .....	68, 931	West Virginia .....	38, 746
Kentucky .....	60, 057	Wisconsin .....	146, 197
Louisiana .....	51, 335	Alaska Territory .....	166
Maine .....	76, 717	Arizona Territory .....	5, 053
Maryland .....	42, 866	Dakota Territory .....	10, 466
Massachusetts .....	184, 603	District of Columbia .....	81, 260
Michigan .....	154, 604	Idaho Territory .....	7, 446
Minnesota .....	83, 625	Indian Territory .....	4, 911
Mississippi .....	46, 043	Montana Territory .....	9, 047
Missouri .....	153, 490	New Mexico Territory .....	8, 252
Nebraska .....	48, 914	Utah Territory .....	17, 432
Nevada .....	20, 509	Washington Territory .....	8, 493
New Hampshire .....	40, 043	Wyoming Territory .....	10, 163
New Jersey .....	56, 347		

The losses of registered matter have been very small. Of the total number of letters transmitted, only 1,049, or about one in every 4,000, were absolutely lost. These losses occurred from various causes; some by robberies of the mail, others by the burning of postal cars and of post-offices—most of them by unavoidable casualties to the service—and no trace of the letters or their contents ever obtained.

The revenues of the Department from the registered-letter system can, I am confident, be materially increased, but it cannot be done without the employment of an additional force of clerks. If postmasters were fully and promptly supplied with blanks and instructions, enabling them to comply with all applications to register letters, there would be at once a large increase in the business. With the present available

force it is impossible to do this. I therefore earnestly recommend an increase over the number now employed, of one clerk of class three, two of class one, and two laborers. With this additional expense of about \$6,500 a year, I do not hesitate to say that the fees could be increased so that the revenues from the registration of letters would, within three years at the longest, amount to at least a half million dollars annually.

An important feature has been added to this branch of the service during the past year by the introduction of the "through registered pouch system," which was established July 1, 1875, and is now in successful operation throughout various sections of the country; embracing at present twenty-eight pouch offices, seventeen of which exchange with the New York office. The advantages arising from the system cover a large field of detail; but I may briefly say, that having been subjected to a most thorough and critical test, it is found to have eminently fulfilled the objects for which it was inaugurated, to wit, affording additional protection to valuable registered matter in transit; relieving the railway mail-service on main lines by preventing accumulation of registered packages; limiting the possibility of tampering with registered packages, and also the field of investigation in case of its occurrence; insuring certainty of transmission between terminal points; preventing numerous handlings of registered packages and hurried transfers at connecting points; and in short, clearly establishing the fact, as shown by its operations since its inauguration, that it is productive of excellent results, and furnishes a foundation on which to improve the registered-letter system, and extend its benefits to the public and the service.

Appended to this paragraph is a schedule, showing the total number of through registered pouches received and dispatched, together with the total number of registered packages received and sent from the post-office at New York City, from July 2, 1875, to June 30, 1876, as a partial indication of the workings and importance of the system.

*Schedule.*

Regular pouches sent.....	4,587	Number of packages sent.....	117,007
Regular pouches received.....	4,380	Number of packages received...	77,508
Transit pouches received.....	1,470	Number of packages in transit..	12,332
<hr/>		<hr/>	
Total pouches handled.....	10,437	Total packages in pouches....	206,847

In the very elaborate and satisfactory report accompanying the above exhibit from the office referred to, the postmaster thereat takes occasion to say that, with an average of nearly twenty-nine packages in each pouch, or an average of two hundred and thirty-five packages pouched daily, (Sundays included,) not a single loss or error has occurred, and urgently recommends the extension of the system throughout all parts of the country where needed. Similar reports have been received from all the other offices, reiterating in substance what has already been said, in commendation of the "through registered pouch system."

DIVISION OF FILES, RECORDS, AND MAILS.

The number of official letters received and disposed of by this division during the year amounted to 928,000.

Of the number received 28,872 were briefed, recorded, and, after being acted upon, filed; and 7,206 letters written in the bureau were copied, enveloped, and stamped for mailing.

The number of circulars stamped and sent out was 137,600.

The number of employés in this division is only four; and, taking into consideration that three of them were at times engaged on other duties, it will be seen that the amount of work performed, in proportion to the number employed, has been extremely large.

Very respectfully, &c.,

EDWARD W. BARBER,  
*Third Assistant Postmaster-General.*

Hon. JAS. N. TYNER,  
*Postmaster-General.*



**No. 2.—*Estimate of indebtedness of the Post-Office Department for fiscal year ended June 30, 1876, not yet adjusted.***

Balances due foreign countries .....		\$33,253 20
Mail-service under contract or recognized, but not yet reported for payment .....		989,069 50
Mail-service unrecognized—		
Fiscal year ended June 30, 1875 .....	\$198,744 00	
Fiscal year ended June 30, 1876 .....	154,280 85	
		<hr/> 353,024 85
		<hr/> 1,375,347 55

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

No. 3.—Statement exhibiting the receipts and expenditures, under appropriate heads, by quarters, and June

## RECEIPTS.

	Quarter ended September 30, 1875.	Quarter ended December 31, 1875.	Quarter ended March 31, 1876.	Quarter ended June 30, 1876.
Letter-postage paid in money.....	\$49,539 24	\$58,937 79	\$65,548 97	\$50,766 37
Book, newspaper, and pamphlet postage.....	148 50	48 69	13 87	.....
Box-rents and branch offices.....	330,607 39	325,963 73	321,478 70	327,877 23
Fines and penalties.....	756 05	1,028 13	989 77	584 06
Postage stamps, stamped envelopes, newspaper-wrappers, and postal cards.....	6,286,129 29	6,832,277 81	7,002,974 39	6,758,136 61
Dead-letters.....	2,866 53	4,380 17	893 00	1,749 50
Miscellaneous.....	7,735 71	7,974 78	6,739 25	7,287 13
Revenue from money-order business.....	.....	.....	.....	190,770 84
	6,677,782 71	7,230,611 10	7,398,637 95	7,337,165 74

Comparison, including revenue from money-order business and official stamps:

Increase of receipts over year ended June 30, 1875, \$1,852,836.91, or 6.4 + per cent.

Increase of receipts over year ended June 30, 1874, \$2,167,125.62, or 7.5 + per cent.

## EXPENDITURES.

Compensation of postmasters.....	\$1,777,353 76	\$1,625,059 83	\$1,931,130 00	\$1,863,854 32
Compensation of postmasters, previous years, act March 3, 1875.....	762 65	370 78	42 00	.....
Compensation of clerks for post-offices.....	864,423 11	864,970 19	854,852 43	896,434 42
Compensation of letter-carriers and incidental expenses.....	490,951 02	497,399 97	497,304 53	495,139 50
Wrapping-paper.....	3,177 22	8,204 80	3,412 50	3,412 50
Twine.....	10,046 40	12,939 39	11,474 50	4,258 00
Postmarking and cancelling stamps.....	2,528 05	1,711 37	2,776 73	1,841 75
Letter-balances.....	677 56	2,123 64	5 13	1,101 06
Rent, light, and fuel for post-offices.....	66,572 09	98,309 53	98,301 77	107,239 32
Stationery.....	11,554 31	9,733 27	11,798 69	10,226 56
Furniture for post-offices.....	5,050 70	4,971 00	3,930 01	5,547 56
Miscellaneous.....	19,125 73	17,561 18	14,324 12	25,011 57
Inland mail transportation.....	3,734,087 96	3,827,899 35	3,564,207 48	3,619,651 16
Compensation of railway post-office clerks.....	287,216 29	296,528 31	319,628 56	320,377 03
Compensation of route-agents.....	230,209 06	238,065 59	232,034 04	239,819 28
Compensation of mail-route messengers.....	38,278 23	35,959 69	36,288 89	36,625 41
Compensation of local agents.....	25,028 21	25,581 09	25,458 71	25,745 26
Compensation of mail-messengers.....	152,568 01	160,321 19	161,067 10	158,691 73
Mail-locks and keys.....	901 25	10,292 30	3,916 15	.....
Mail-bags and catchers.....	34,286 77	62,395 25	64,009 83	45,825 64
Post-route maps.....	8,855 60	8,278 46	6,528 86	.....
Mail deprecations and special agents.....	36,831 71	33,620 40	35,919 66	12,305 17
Postage stamps.....	28,468 43	28,466 16	52,711 71	11,141 78
Distribution of postage stamps.....	2,067 35	1,508 50	988 74	486 26
Stamped envelopes and newspaper-wrap- pers.....	109,898 98	109,444 82	109,027 69	30,228 65
Distribution of stamped envelopes and newspaper-wrappers.....	3,205 43	2,929 48	2,625 22	1,260 97
Postal cards.....	59,050 10	53,392 59	56,016 42	13,663 68
Distribution of postal cards.....	1,760 34	771 98	1,076 10	420 32
Registered-package envelopes, locks, and seals.....	1,350 66	6,790 29	11,196 03	12,830 61
Official envelopes for postmasters.....	3,735 95	2,878 40	5,242 48	3,566 48
Dead-letter envelopes.....	.....	753 00	696 00	800 40
Ship, steamboat, and way letters.....	1,329 43	971 70	844 17	926 53
Fees to United States marshals, attor- neys, clerks of court, and counsel.....	743 98	1,192 27	2,001 74	965 29
Engraving, printing, and binding drafts and warrants.....	376 25	408 25	965 00	1 50
Advertising.....	30,910 98	19,458 56	4,026 25	32,459 35
Miscellaneous.....	361 73	173 58	474 15	611 05
Foreign mail transportation.....	52,844 57	65,038 12	60,557 86	50,682 71
Balances due foreign countries.....	24,728 76	323 09	4,325 21	3,876 14
Official postal guides.....	6,500 62	2,965 52	6,515 64	2,971 05
Subsidies—China and Brazil lines.....	162,500 00	125,000 00	125,000 00	125,000 00
	8,310,319 30	8,465,411 90	8,322,706 22	8,165,050 07

## REPORT OF THE POSTMASTER-GENERAL.

25

for the fiscal year ended June 30, 1876, compared with fiscal years ended June 30, 1875, 30, 1874.

## RECEIPTS.

Total, year ended June 30, 1876.	Total expenditures for previous fiscal years.	Total, year ended June 30, 1875.	Compared with year ended June 30, 1875.		Total, year ended June 30, 1874.	Compared with year ended June 30, 1874.	
			Increase.	Decrease.		Increase.	Decrease.
\$234,792 37	.....	\$286,969 04	.....	\$62,176 67	\$326,295 25	.....	\$101,502 88
811 06	.....	579,384 95	.....	579,153 89	1,392,374 06	.....	1,392,163 00
1,305,927 05	.....	1,270,554 23	\$35,372 82	.....	1,226,925 85	\$79,001 20	.....
3,358 01	.....	14,286 29	.....	10,928 28	10,711 12	.....	7,353 11
26,879,512 10	.....	24,490,942 23	2,388,569 67	.....	23,388,722 20	3,490,789 90	.....
9,689 20	.....	9,180 00	709 20	.....	8,721 00	1,168 20	.....
29,736 87	.....	19,921 76	9,815 11	.....	18,124 22	11,612 63	.....
190,770 84	.....	120,142 09	70,628 75	.....	105,198 12	85,572 72	.....
23,644,197 50	.....	26,791,360 59	2,505,095 75	652,258 84	26,477,071 82	3,662,144 67	1,501,018 99
26,791,360 59	.....	.....	652,258 84	.....	26,644,197 50	1,501,018 99	.....
1,852,836 91	.....	.....	1,852,836 91	.....	2,167,125 68	2,167,125 68	.....

Comparison, excluding revenue from money-order business and official postage-stamps:

Increase of receipts over year ended June 30, 1875, \$1,650,493.41, or 5.7 + per cent.

Increase of receipts over year ended June 30, 1874, \$2,813,542.33, or 9.9 + per cent.

## EXPENDITURES.

\$7,397,397 91	\$15,837 40	\$7,049,935 77	.....	\$5,818,472 17	.....
1,175 43	1,175 43	298,187 33	.....	.....	.....
3,480,730 15	763 90	3,414,811 26	.....	3,297,961 77	.....
1,900,795 02	.....	1,879,210 11	.....	1,802,418 68	.....
18,207 02	.....	11,567 10	.....	20,200 00	.....
32,718 29	.....	43,811 57	.....	.....	.....
8,857 90	.....	5,943 28	.....	.....	.....
3,907 39	.....	19,449 24	.....	.....	.....
390,422 77	.....	389,638 85	.....	.....	.....
43,312 83	.....	39,427 61	.....	.....	.....
19,499 27	.....	16,264 31	.....	32,711 90	.....
76,092 66	.....	.....	.....	.....	.....
14,745,245 95	424,343 35	14,777,201 20	.....	14,881,319 05	.....
1,223,750 19	.....	.....	.....	.....	.....
940,151 97	.....	.....	.....	.....	.....
147,152 27	.....	.....	.....	.....	.....
101,813 27	.....	.....	.....	.....	.....
632,649 03	.....	.....	.....	.....	.....
15,709 70	.....	31,811 42	.....	48,097 25	.....
206,517 49	29 40	187,148 08	.....	212,714 76	.....
23,663 92	.....	30,357 91	.....	.....	.....
118,676 94	.....	150,693 77	.....	165,478 63	.....
120,788 08	.....	.....	.....	.....	.....
5,050 85	.....	.....	.....	845,196 08	.....
358,600 14	.....	724,186 84	.....	.....	.....
10,021 16	.....	.....	.....	.....	.....
182,122 79	.....	.....	.....	.....	.....
4,027 84	.....	.....	.....	.....	.....
32,167 59	.....	.....	.....	.....	.....
15,423 31	.....	.....	.....	.....	.....
2,279 40	.....	2,312 42	.....	5,983 89	.....
4,071 83	.....	3,753 18	.....	4,182 42	.....
4,903 28	.....	.....	.....	.....	.....
1,751 00	.....	.....	.....	.....	.....
86,855 14	.....	168,381 20	.....	109,740 68	.....
1,620 51	.....	178,434 53	.....	677,046 35	.....
229,123 28	.....	.....	.....	.....	.....
33,253 80	25,051 85	121,732 52	.....	204,284 95	.....
12,952 83	.....	6,450 00	.....	.....	.....
537,500 00	.....	.....	.....	.....	.....
32,363,487 58	467,301 42	33,611,309 45	.....	32,126,414 58	.....

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

## No. 4.—Receipts and disbursements at Treasury

Depositories.	Deposits.	Grants from Treas- ury.	By transfer.	Aggregate accumu- lation.	Aggregate receipts.
Treasurer U. S., Washington, D. C.	\$743, 756 94		\$343, 067 78	\$1,086, 824 72	\$743, 756 94
Asst. treasurer U. S., Baltimore, Md.	151, 838 99		50, 000 00	201, 838 99	151, 838 99
Asst. treasurer U. S., Boston, Mass.	570, 600 87		25, 000 00	595, 600 87	570, 600 87
Asst. treasurer U. S., Charleston, S. C.	28, 696 01		300, 000 00	328, 696 01	28, 696 01
Asst. treasurer U. S., Chicago, Ill.	263, 636 23		1, 250, 000 00	1, 513, 636 23	263, 636 23
Asst. treasurer U. S., Cincinnati, Ohio.	260, 082 51			260, 082 51	260, 082 51
Asst. treasurer U. S., New Orleans, La.	64, 557 19		375, 000 00	439, 557 19	64, 557 19
Asst. treasurer U. S., New York, N. Y.	2, 297, 402 11	\$5,089, 776 50	400, 000 00	7, 787, 178 61	7, 387, 178 61
Asst. treasurer U. S., Philadelphia, Pa.	533, 511 76			533, 511 76	533, 511 76
Asst. treasurer U. S., San Francisco, Cal.	307, 440 75			307, 440 75	307, 440 75
Asst. treasurer U. S., Saint Louis, Mo.	222, 214 37		875, 000 00	1, 097, 214 37	222, 214 37
Designated depository, Buffalo, N. Y.	1, 000 00			1, 000 00	1, 000 00
Designated depository, Pittsburgh Pa.					
Designated depository, Santa Fe, N. Mex.	220 90			220 90	220 90
First Nat'l Bank, Denver, Colo.					
First Nat'l Bank, Dubuque, Iowa.	285 30			285 30	285 30
First Nat'l Bank, Galveston, Tex.	4, 527 22			4, 527 22	4, 527 22
First Nat'l Bank, Leavenworth, Kans.	1, 180 99			1, 180 99	1, 180 99
First Nat'l Bank, Memphis, Tenn.	252 38			252 38	252 38
First Nat'l Bank, Nashville, Tenn.	1, 465 84			1, 465 84	1, 465 84
First Nat'l Bank, Portland, Oreg.	1, 387 28			1, 387 28	1, 387 28
First Nat'l Bank, Portsmouth, N. H.	560 00			560 00	560 00
First Nat'l Bank, Providence, R. I.					
First Nat'l Bank, Richmond, Va.	32 20			32 20	32 20
First Nat'l Bank, Springfield, Ill.	699 28			699 28	699 28
First Nat'l Bank, Saint Paul, Minn.	179 71			179 71	179 71
First Nat'l Bank, Trenton, N. J.					
First Nat'l Bank, Yankton, Dak.	92 07			92 07	92 07
Second Nat'l Bank, Detroit, Mich.	125 00			125 00	125 00
Second Nat'l Bank, New Haven, Conn.					
Merchants' Nat'l Bank, Cleveland, Ohio.	193 85			193 85	193 85
Merchants' Nat'l Bank, Little Rock, Ark.	3, 748 12			3, 748 12	3, 748 12
Merchants' Nat'l Bank, Portland, Me.	10 00			10 00	10 00
Merchants' Nat'l Bank, Savannah, Ga.	876 21			876 21	876 21
Atlanta Nat'l Bank, Atlanta, Ga.	440 00			440 00	440 00
Charter Oak Nat'l Bank, Hartford, Conn.					
City Nat'l Bank, Grand Rapids, Mich.	267 19			267 19	267 19
Colorado Nat'l Bank, Denver, Colo.	273 00			273 00	273 00
East Tenn. Nat'l Bank, Knoxville, Tenn.	36 59			36 59	36 59
Exchange Nat'l Bank, Norfolk, Va.	50 00			50 00	50 00
Indianapolis N'l B'k, Indianapolis, Ind.	978 20			978 20	978 20
German Nat'l Bank, Memphis, Tenn.	478 30			478 30	478 30
Nat'l Exchange Bank, Milwaukee, Wis.					
Raleigh Nat'l Bank, Raleigh, N. C.					
San Antonio N'l B'k, San Antonio, Tex.	68 95			68 95	68 95
Total	5, 463, 166 31	5, 089, 776 50	3, 618, 067 78	1, 417, 010 59	10, 552, 942 81

## Comparative statement between fiscal years

Deposits for fiscal year of 1876.	\$5, 463, 166 31
Deposits for fiscal year of 1875.	4, 809, 392 92
Increase in deposits for 1876	653, 773 39
Grants from the Treasury for 1875	\$7, 900, 534 80
Grants from the Treasury for 1876	5, 089, 776 50
Decrease in grants for 1876	2, 810, 758 30
Aggregate receipts for 1875	12, 709, 927 72
Aggregate receipts for 1876	10, 552, 942 81
Decrease in aggregate receipts for 1876	2, 156, 984 91
Increase of grants from Treasury for 1875	2, 810, 758 30
Deduct increase of deposits for 1876	653, 773 39
Balance	2, 156, 984 91
Increase of receipts for 1876	852, 387 13
Decrease of receipts for 1876	198, 613 74
Increase for 1876, as shown above.	653, 773 39

depositories during the fiscal year ended June 30, 1876.

Increase of receipts over 1875.	Decrease of receipts from 1875.	Warrants drawn.	Increase over 1875.	Decrease from 1875.	Transfer account.		Balance sub- ject to draft June 30, 1876.
					From—	To—	
\$407,201 84		\$723,206 53		\$94,931 17	\$400,000 00	\$343,067 78	\$11,224 92
	\$699 01	229,967 14		62,055 76		50,000 00	31,510 67
	15,173 33	622,032 25	\$24,388 15			25,000 00	60,451 82
	7,090 60	329,291 01		5,755 17		300,000 00	20,466 43
204,920 46		1,459,350 59	198,446 43			1,250,000 00	70,600 73
	60,684 26	285,342 13		105,692 07	50,000 00		49,930 81
	690 35	433,094 17		63,664 77		375,000 00	39,078 53
62,492 96		5,146,591 17		702,380 12	3,150,000 00	400,000 00	298,452 78
25,639 41		461,732 44	7,796 75				214,015 08
	81,461 10	350,274 68		2,039 82			43,016 15
135,769 18		1,084,042 06	76,222 12			875,000 00	17,153 53
	362 96				850 00		500 00
	923 75						
	516 50				510 90		
	1,188 52						
285 30					285 30		
1,587 72					3,526 81		2,759 99
1,180 99					1,118 24		62 75
	2,710 26				2,432 02		252 38
	492 61				2,117 36		861 83
1,176 14					823 87		583 66
560 00					560 00		
	561 60						
32 20							32 20
170 15					435 98		699 28
60 06					179 71		
	1,221 27						
	610 16				92 07		
	200 00				325 00		125 00
	349 60						
	24 64				45 00		148 85
3,714 87					840 82		2,834 36
9 00					11 00		
	20,911 63				769 11		87 10
43 30					415 00		25 00
	512 60						
967 19					267 19		
273 00							273 00
36 59							36 59
33 03							50 00
43 37					579 05		922 25
	945 30				1,794 40		
	50 00						
	1,903 94						
	19 90				68 95		
852,387 13	198,613 74	11,124,924 17	306,853 45	1,036,518 82	3,618,067 78	3,618,067 78	866,175 09

of 1875 and 1876 at Treasury depositories.

Warrants drawn for 1875.....	\$11,854,589 60	
Warrants drawn for 1876.....	11,124,924 17	
Decrease of warrants for 1876.....		\$1,036,518 88
Deduct increase of warrants for 1876.....		306,853 45
	729,665 43	729,665 43
Balance subject to draft June 30, 1875.....		1,427,689 62
Balance subject to draft June 30, 1876.....		866,175 09
Decrease for 1876.....		561,513 93
Total number of warrants issued during fiscal year 1876.....		13,456
Total number of warrants issued during fiscal year 1875.....		12,278
Increase for 1876.....		1,178

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

## REPORT OF THE POSTMASTER-GENERAL.

No. 5.—Receipts and disbursements at depository post-offices, on account of the fiscal year ended June 30, 1876.

Office.	State.	Proccs.	Deposits.	Collections.	Aggregate accumulations.	Amount subject to draft June 30, 1875.	Credit-balance June 30, 1875.	Total.	Disbursements.	Amount subject to draft June 30, 1876.	Credit-balance June 30, 1876.
Adrian	Michigan	\$5,159 20	\$776 75	\$1 99	\$5,855 54	\$2,111 77		\$7,967 31	\$6,659 53	\$1,307 78	
Albany	New York	98,740 64	27,533 83		126,274 47	17,388 30		143,662 77	137,154 95	6,487 82	
Albia	Iowa	2,003 97	1,077 42	126 42	3,207 81	449 73		3,657 54	2,119 45	1,538 09	
Atlanta	Georgia	26,853 29	5,260 40	1,459 34	33,573 03		\$1 22	33,571 81	34,179 32	6,034 37	\$603 51
Auburn	New York	26,513 32	3,558 09	65 47	29,934 88	5,629 05		35,563 93	30,529 56		
Augusta	Maine	20,249 59	1,134 19	74 61	21,458 39	3,713 03		25,171 42	23,141 42	2,030 00	
Austin	Texas	20,249 59	1,134 19	2,575 30	23,705 76	16,210 03		29,915 79	20,472 27	9,443 52	
Bangor	Maine	14,253 14	1,911 42	15 76	16,210 03	908 86		17,118 89	16,335 26	783 63	
Batavia	New York	3,870 53	1,411 42		5,281 95	2,831 94		6,113 89	5,168 08	1,575 81	
Bay City	Michigan	6,550 66	2,282 86	267 54	7,222 86	1,779 21		8,998 13	6,869 18	2,128 95	
Birmingham	New York	17,365 86	6,932 79	84 77	24,423 42	1,375 21		25,800 63	23,067 75	2,714 88	
Burlington	Vermont	13,015 23	4,333 26	15 08	17,348 59	1,266 86		18,615 45	17,032 53	1,582 92	
Charleston	Illinois	3,301 86	310 25	1 67	3,612 11	2,353 49		4,965 60	4,313 84	641 76	
Cincinnati	Ohio	153,874 92	11,793 21		165,668 10	17,925 49		182,925 97	162,076 74	20,848 55	
Columbus	do	14,698 16	1,784 12		16,482 28	2,303 93		18,786 21	17,032 53	1,753 68	
Concord	New Hampshire	3,361 10	10,323 24		50,250 04	2,400 04		52,650 08	49,251 40	3,398 68	
Decorah	Iowa	17,467 37	5,869 77		23,337 14	74 58		23,411 72	22,516 40	895 32	
Des Moines	Iowa	31,678 92	23,019 50		54,698 42	1,525 11		56,223 53	54,635 15	1,588 38	
Detroit	Michigan	144,726 98	3,447 68	323 86	148,174 66	3,634 87		151,809 53	144,143 71	7,665 82	
Dubuque	Iowa	21,845 40	2,861 46	13 61	24,720 46	15,635 90		40,356 36	23,772 86	16,583 50	
East Saginaw	Michigan	9,404 24	1,653 64		11,057 88	412 16		11,470 04	9,090 12	2,379 92	
Elmira	New York	18,846 05	2,463 18	449 05	21,758 28			22,207 33	22,115 05	92 28	
Evansville	Indiana	15,740 56	967 49	271 77	16,979 82	141 68		17,121 50	14,816 50	2,305 00	
Fort Dodge	Iowa	14,538 93	1,399 37	15 30	15,953 60	517 76		16,471 36	13,463 06	3,008 30	
Fort Wayne	Indiana	15,740 56	967 49	271 77	16,979 82	141 68		17,121 50	14,816 50	2,305 00	
Grand Rapids	Michigan	13,439 46	4,321 73	253 35	18,014 54	933 50		18,948 04	19,103 81	2,164 25	
Harrisburgh	Pennsylvania	4,407 14	2,572 62	57 02	6,936 78	2,518 23		9,455 01	42,671 35	6,561 21	
Hartford	Connecticut	8,407 14	2,358 31	1 49	10,766 94	4,437 93		15,204 87	90,066 35	7,018 52	
Houghton	Michigan	1,213 17	8,256 21		9,469 38	2,964 27		12,433 65	5,915 16	6,518 49	
Houston	Texas	13,567 36	1,774 98	67 93	15,409 27	330 93		15,740 20	13,535 31	2,204 89	
Huntsville	Alabama	2,042 28	258 91		2,301 19	371 36		2,672 55	2,906 17	285 92	
Indianapolis	Indiana	100,492 91	2,184 74	502 71	103,180 37	1,845 53		105,025 90	102,614 63	2,411 27	
Iowa City	Iowa	7,241 61	1,349 39	256 50	7,613 70	1,714 61		9,328 31	6,092 66	3,235 65	
Jack sonville	Florida	4,362 30	2,131 63	26 52	6,559 45	1,990 20		8,549 65	11,408 42	1,448 42	
James town	New York	6,286 13	2,363 17	26 52	8,387 82	5,533 70		13,921 52	9,904 26	4,017 26	
Kalamazoo	Michigan	11,152 59	1,564 01	137 60	12,854 20	5,533 70		18,387 90	14,431 50	3,956 40	
Kennebunk	New Hampshire	5,020 04	888 39		5,908 43	2,067 83		7,976 26	5,124 18	2,852 08	
Keokuk	Iowa	14,217 76	233 27	53 36	14,404 29	2,067 83		16,472 12	13,297 08	3,275 04	
Knoxville	Tennessee	8,546 06	1,770 59	23 68	10,340 33	1,073 76		11,414 09	9,933 74	1,480 35	
La Fayette	Indiana	9,114 79	1,136 24	23 68	10,274 71	1,858 37		12,133 07	12,401 84	2,607 29	
Lansing	Michigan	9,668 60	1,447 38	1,447 32	11,563 30			13,010 62	11,212 34	1,798 28	

Leavenworth	12,374 92	6,067 45	517 07	15,970 44	144 70	18,704 74	15,000 10	104 61
Lexington	11,466 40	48 30	024 40	1,006 91	1,006 91	12,165 47	11,410 46	1,755 90
Lima	4,220 34	2,501 71	50 72	4,001 08	4,001 08	10,767 57	8,707 14	2,075 57
Louisville	130,740 91	3,716 11	109 41	134,318 72	2,410 60	132,922 40	132,922 40	2,410 60
Madison	15,510 34	1,368 40	130 62	17,357 07	353 25	17,009 32	16,135 48	873 80
Malone	2,092 23	1,109 65	.....	2,191 88	1,367 17	3,519 55	2,342 49	1,177 06
Marquette	2,201 40	577 54	6 01	2,874 95	886 12	3,711 07	3,140 57	671 50
Marshalltown	5,412 51	10 00	510 00	5,932 51	116 68	10,155 33	5,117 92	697 91
Memphis	7,740 51	2,203 45	18 34	9,951 30	194 03	10,155 33	9,419 50	735 83
Milwaukee	45,726 84	9,967 04	1,363 08	50,693 96	1,345 86	48,711 10	49,830 50	1,863 46
Mobile	121,193 88	6,129 52	1,968 59	128,634 96	2,330 45	128,634 96	128,634 96	2,330 45
Montpelier	94,993 89	3,640 13	1,907 99	98,573 01	221 84	98,200 54	98,200 54	372 46
Montpelier	5,482 67	1,617 12	.....	7,099 79	1,474 45	8,574 24	6,044 08	2,530 16
Mount Pleasant	2,918 43	50 75	.....	2,969 18	1,604 10	3,573 28	2,900 27	673 01
Nashville	34,896 93	2,144 75	36 88	37,041 73	228 08	36,813 63	36,813 63	228 08
New Jersey	73,573 43	1,214 92	.....	80,625 22	22,833 20	103,638 42	85,091 13	18,547 29
New Bedford	19,500 90	1,043 90	83 11	20,543 80	350 18	21,634 04	18,039 86	3,593 18
New Brunswick	65,716 32	10,733 30	192 00	82,332 64	5,009 85	87,342 49	81,978 76	5,363 73
New York	3,502 91	1,286 31	192 00	4,961 22	923 96	5,905 18	5,092 42	812 76
do	5,747 32	1,613 86	.....	7,361 18	368 44	7,729 62	6,350 50	1,379 12
Ogdenburgh	2,907 63	921 65	434 83	3,829 48	327 87	4,156 31	3,181 03	975 28
Omaha	22,535 76	27,821 10	25,900 05	72,256 91	1,782 73	74,038 66	71,704 80	2,333 86
Peoria	30,269 64	6,899 57	14 64	37,168 85	188 65	37,168 85	37,168 85	188 65
Pittsburgh	171,198 41	5,637 18	12 52	176,838 11	12,449 25	189,287 36	173,419 13	15,868 23
Plattsburgh	4,068 31	5,507 97	18 36	9,576 28	268 51	10,144 79	8,106 56	2,038 23
Portland	59,801 20	9,188 72	48 29	68,989 91	3,135 93	71,574 14	59,316 69	12,257 45
Portsmouth	6,285 03	8,128 71	.....	14,413 74	1,743 90	16,157 64	14,746 18	1,411 46
Portsmouth	5,610 53	4,533 22	153 60	10,319 35	557 05	10,876 40	9,672 10	1,204 30
Providence	104,204 87	28,207 11	.....	132,411 98	6,603 81	139,015 79	115,510 93	23,504 86
Rhode Island	12,808 77	3,148 73	512 71	16,470 21	3,115 67	15,224 75	15,018 23	206 52
Raleigh	54,237 94	6,218 07	2,174 98	62,630 99	9,951 50	65,746 66	61,393 74	4,352 92
Richmond	104,225 50	4,451 94	4,324 82	113,002 35	9,951 50	122,393 85	115,572 21	6,821 61
Rochester	5,438 71	2,869 61	22 22	8,350 54	291 24	8,641 78	7,621 29	1,020 49
Rutland	4,066 20	1,776 72	.....	4,263 01	2,003 19	6,266 34	4,961 17	1,305 17
Saint Albans	4,263 58	2,985 01	1,293 11	7,247 64	831 19	8,032 83	6,920 31	1,112 52
Saint Johnsbury	44,463 81	16,594 15	2,447 02	63,524 98	758 21	63,773 16	59,911 78	3,861 38
Saint Paul	24,733 42	2,905 03	469 96	25,408 41	151 22	24,724 19	25,564 69	860 50
Sandusky	14,095 04	1,691 24	36 93	15,786 28	684 22	16,224 33	13,517 76	2,706 57
Savannah	16,194 61	1,869 32	58 17	17,068 70	170 80	17,796 89	16,056 62	1,740 27
Springfield	47,069 38	5,011 99	.....	52,101 37	5,499 05	57,600 42	54,687 43	2,912 99
Springfield	5,844 28	783 36	9,359 34	6,637 64	9,615 78	7,439 02	7,439 02	7,439 02
Steuersville	57,577 38	3,671 32	.....	63,606 05	7,084 18	70,702 23	63,677 40	7,024 83
Syracuse	14,318 69	1,124 39	443 84	15,661 46	1,506 54	17,168 02	16,361 08	806 94
Taunton	9,082 02	2,018 01	101,543 93	175,207 12	1,730 95	176,938 07	170,228 99	6,709 08
Terre Haute	2,401 75	206 55	149 05	2,608 31	839 46	2,894 41	2,894 41	839 46
Towanda	4,798 26	5,304 60	.....	43,673 21	15,294 64	6,093 32	4,714 40	1,378 92
Towanda	38,368 61	5,304 60	.....	43,673 21	15,294 64	6,093 32	4,714 40	1,378 92
Utica	13,812 96	1,500 00	.....	13,812 96	2,207 40	16,111 86	14,078 31	2,033 55
Watertown	1,202 75	545 58	8 78	1,757 11	1,100 88	2,857 99	2,564 75	293 24
Wellborough	.....	.....	.....	.....	.....	.....	.....	.....
Wellborough	.....	.....	.....	.....	.....	.....	.....	.....

No. 5.—Receipts and disbursements at depository post-offices, &amp;c.—Continued.

Office.	State.	Proceeds.	Deposits.	Collections.	Aggregate accumulations.	Amount subject to draft, June 30, 1875.	Credit balance June 30, 1875.	Total.	Disbursements.	Amount subject to draft, June 30, 1876.	Credit balance June 30, 1876.
Wheeling .....	West Virginia	\$17,624 26	\$1,413 61	.....	\$19,087 87	\$5,575 19	.....	\$24,673 06	\$22,961 11	\$1,711 95	.....
Williamsport .....	Pennsylvania	13,876 59	217 38	.....	14,093 97	1,935 13	.....	16,029 10	15,063 75	965 35	.....
Winona .....	Minnesota	6,455 16	1,537 99	.....	8,019 91	698 31	.....	8,718 22	7,715 86	1,002 36	.....
Worcester .....	Ohio	3,805 18	662 21	\$26 76	4,467 39	5,999 71	.....	9,737 10	8,292 72	1,444 38	.....
Worcester .....	Massachusetts	53,158 88	4,433 97	.....	57,592 85	2,148 76	.....	59,741 61	54,771 03	4,970 58	.....
Zanesville .....	Ohio	11,099 17	531 26	.....	11,630 43	3,759 86	.....	15,383 29	12,769 44	2,613 85	.....
Total .....		2,784,217 08	359,290 69	163,737 10	3,307,244 87	258,069 33	\$6,493 02	3,859,421 18	3,241,846 46	321,947 66	\$4,372 94

EDWARD W. BARBER,  
Third Assistant Postmaster-General.



No. 6.—*Postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the fiscal year ending June 30, 1876.*

## ORDINARY POSTAGE-STAMPS.

Quarter ending—	NUMBER AND DENOMINATION OF STAMPS.									Amount.
	1-cent.	2-cent.	3-cent.	5-cent.	6-cent.	10-cent.	15-cent.	30-cent.	90-cent.	
September 30, 1875 .....	25,036,600	16,647,000	112,466,600	3,241,620	1,394,550	1,243,620	131,320	40,460	4,100	\$4,393,946 00
December 31, 1875 .....	30,909,700	19,696,200	120,030,400	2,033,420	1,950,200	1,188,910	283,440	119,260	6,940	4,723,143 00
March 31, 1876 .....	33,427,300	19,934,400	120,040,200	2,510,860	1,830,900	1,970,530	331,860	109,040	9,360	4,872,850 00
June 30, 1876 .....	35,853,200	18,280,000	121,529,000	2,123,400	1,949,850	1,595,670	215,140	89,660	2,900	4,814,515 00
Total .....	125,226,800	74,557,600	474,666,200	9,909,300	7,145,500	5,998,730	942,160	349,440	23,360	18,773,454 00

## NEWSPAPER AND PERIODICAL STAMPS.

Quarter ending—	NUMBER AND DENOMINATION OF STAMPS.												
	2-cent.	3-cent.	4-cent.	6-cent.	8-cent.	9-cent.	10-cent.	12-cent.	24-cent.	36-cent.	48-cent.	60-cent.	72-cent.
September 30, 1875.....	60,955	23,085	30,495	32,325	14,920	5,920	31,520	20,770	16,830	8,025	6,975	6,025	2,430
December 31, 1875.....	59,675	21,470	28,030	25,905	12,515	3,630	32,500	22,535	18,335	9,250	8,065	7,550	2,550
March 31, 1876.....	74,265	27,060	35,750	34,570	20,940	6,080	44,320	25,995	22,925	11,875	10,260	10,530	5,825
June 30, 1876.....	64,770	23,780	31,550	32,785	16,440	6,420	38,070	24,580	22,960	11,105	9,565	9,280	4,915
Total.....	263,665	95,935	126,125	125,585	64,815	22,650	146,410	93,900	81,050	40,255	34,605	32,310	15,720

## NUMBER AND DENOMINATION OF STAMPS—Continued.

Quarter ending—	NUMBER AND DENOMINATION OF STAMPS.											Amount.
	84-cent.	96-cent.	\$1. 92.	\$3. 00.	\$6. 00.	\$9. 00.	\$12. 00.	\$24. 00.	\$36. 00.	\$48. 00.	\$60. 00.	
September 30, 1875.....	2,790	11,460	6,220	6,719	3,799	2,571	2,319	1,636	529	353	691	\$261,974 55
December 31, 1875.....	3,185	9,040	5,215	6,319	1,673	1,424	1,672	404	515	96	648	184,949 80
March 31, 1876.....	5,045	11,300	7,050	7,204	3,682	1,781	2,078	588	439	232	807	243,701 90
June 30, 1876.....	4,570	10,695	6,415	5,874	2,921	1,576	1,884	763	618	513	900	254,628 50
Total.....	15,560	43,395	24,970	26,116	12,075	7,352	7,853	3,390	2,101	1,174	3,046	945,254 75

No. 6.—*Postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the fiscal year ending June 30, 1876—Continued.*

ORDINARY STAMPED ENVELOPES AND WRAPPERS.

Quarter ending—	NUMBER AND DENOMINATION OF ENVELOPES.									NEWSPAPER-WRAPPERS.		Amount.
										1-cent.	2-cent.	
	1-cent.	2-cent.	3-cent.	5-cent.	6-cent.	10-cent.	15-cent.	30-cent.	90-cent.			
September 30, 1875.....	3,962,500	555,500	13,530,400	171,750	21,700					2,884,250	1,682,750	\$583,514 33
December 31, 1875.....	5,297,500	1,191,000	13,116,000	26,000	58,600					3,031,250	1,575,000	639,022 95
March 31, 1876.....	5,217,750	890,500	15,057,500	41,250	46,900			100	100	3,412,250	1,567,000	632,165 52
June 30, 1876.....	4,911,250	733,000	15,574,600	21,250	29,750	1,250	350	250	250	2,577,250	1,828,000	639,339 44
Total.....	19,389,000	3,330,000	59,328,500	960,250	156,950	1,250	350	350	350	11,845,000	6,653,750	2,534,042 24

STAMPED ENVELOPES BEARING A REQUEST TO RETURN.

Quarter ending—	NUMBER AND DENOMINATION OF ENVELOPES.						Amount.
	1-cent.	2-cent.	3-cent.	5-cent.	6-cent.	15-cent.	
September 30, 1875 .....	378,000	417,000	14,132,250	4,000	41,000	500	\$492,851 00
December 31, 1875 .....	475,000	542,500	16,090,250	7,500	36,000	500	548,903 45
March 31, 1876 .....	405,500	523,500	15,413,000	5,500	57,000	.....	526,944 35
June 30, 1876 .....	382,000	529,000	15,139,000	2,500	42,500	500	518,789 50
Total .....	1,640,500	2,012,000	60,704,500	19,500	176,500	1,500	2,079,578 30

## POSTAL CARDS.

Quarter ending—	Number of cards	Amount.
September 30, 1875	30, 647, 500	\$306, 475 00
December 31, 1875	41, 968, 500	419, 885 00
March 31, 1876	40, 103, 500	401, 035 00
June 30, 1876	38, 075, 500	380, 755 00
Total	150, 815, 000	1, 508, 150 00

## OFFICIAL POSTAGE-STAMPS.

Quarter ending—	NUMBER AND DENOMINATION OF STAMPS.												Amount.
	1-cent.	2-cent.	3-cent.	6-cent.	7-cent.	10-cent.	12-cent.	15-cent.	24-cent.	30-cent.	90-cent.	\$2.	
September 30, 1875.....	449, 700	268, 600	3, 108, 300	581, 150	4, 600	28, 975	35, 445	13, 570	10, 050	23, 400	5, 700	.....	\$192, 037 40
December 31, 1875.....	47, 000	29, 400	1, 890, 250	113, 400	4, 100	9, 100	10, 900	4, 470	7, 650	6, 900	2, 900	.....	74, 315 00
March 31, 1876.....	98, 200	164, 700	2, 732, 350	175, 500	6, 110	27, 450	32, 410	6, 070	3, 530	17, 840	6, 625	500	117, 610 00
June 30, 1876.....	407, 350	451, 900	5, 528, 700	960, 000	3, 300	207, 400	56, 850	28, 900	24, 100	86, 950	10, 310	.....	309, 848 50
Total.....	1, 002, 250	914, 600	13, 249, 600	1, 830, 050	18, 110	272, 925	135, 605	53, 010	45, 330	135, 090	25, 595	500	663, 831 50

## OFFICIAL STAMPED ENVELOPES AND WRAPPERS.

Quarter ending—	NUMBER AND DENOMINATION OF ENVELOPES.										NEWSPAPER-WRAP- PERS.		Amount.
	1-cent.	2-cent.	3-cent.	6-cent.	10-cent.	12-cent.	15-cent.	30-cent.	1-cent.	2-cent.	1-cent.	2-cent.	
September 30, 1875	.....	102, 500	2, 393, 400	61, 900	.....	.....	.....	.....	.....	.....	600, 000	100	\$64, 300 43
December 31, 1875	.....	146, 000	2, 957, 500	45, 000	.....	.....	.....	.....	.....	.....	400, 000	.....	39, 333 40
March 31, 1876	.....	191, 500	3, 941, 350	168, 100	.....	.....	.....	.....	.....	.....	600, 000	.....	117, 886 50
June 30, 1876	200	156, 000	3, 659, 150	67, 300	25	100	20	10	20	10	900, 000	.....	137, 570 61
Total	200	596, 000	12, 951, 400	342, 300	25	100	20	10	20	10	2, 500, 000	100	499, 110 93

No. 6.—*Postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the fiscal year ended June 30, 1876—Continued.*

RECAPITULATION.

Articles.	Whole number.	Value.
Ordinary postage-stamps .....	698,799,090	\$18,773,454 00
Newspaper and periodical stamps .....	1,290,347	945,254 75
Ordinary stamped envelopes—plain .....	82,467,000	2,980,318 74
Ordinary stamped envelopes—request .....	64,554,500	2,079,578 30
Newspaper-wrappers .....	18,498,750	973,783 50
Postal cards .....	150,815,000	1,504,150 00
Official postage-stamps .....	17,682,665	663,831 50
Official stamped envelopes and wrappers .....	15,690,155	499,110 93
<b>Aggregate .....</b>	<b>1,049,797,507</b>	<b>26,953,431 73</b>

EDWARD W. BARBER,  
*Third Assistant Postmaster-General.*

No. 7.—*Postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards issued during the fiscal year ended June 30, 1876.*

Description.	Quarter ending September 30, 1875.	Quarter ending December 31, 1875.	Quarter ending March 31, 1876.	Quarter ending June 30, 1876.	Total.
<i>Ordinary postage-stamps.</i>					
One-cent .....	25, 036, 600	30, 909, 700	33, 427, 300	35, 853, 200	125, 226, 800
Two-cent .....	16, 647, 000	19, 696, 200	19, 934, 400	18, 280, 000	74, 557, 600
Three-cent .....	112, 466, 600	120, 030, 400	120, 640, 200	121, 529, 000	474, 666, 200
Five-cent .....	3, 241, 620	2, 033, 420	2, 510, 860	2, 123, 400	9, 909, 300
Six-cent .....	1, 394, 550	1, 950, 200	1, 630, 900	1, 949, 850	7, 125, 500
Ten-cent .....	1, 943, 620	1, 188, 910	1, 970, 530	1, 595, 670	5, 698, 730
Fifteen-cent .....	131, 320	263, 840	331, 860	215, 140	942, 160
Thirty-cent .....	40, 460	119, 260	100, 040	89, 640	349, 400
Ninety-cent .....	4, 100	6, 980	9, 380	2, 900	23, 360
Value .....	\$4, 362, 946 00	\$4, 723, 143 00	\$4, 872, 850 00	\$4, 814, 515 00	\$18, 773, 454 00
<i>Newspaper and periodical stamps.</i>					
Two-cent .....	60, 955	59, 675	78, 265	64, 770	263, 665
Three-cent .....	23, 085	21, 470	27, 600	23, 780	95, 935
Four-cent .....	30, 495	28, 030	35, 750	31, 850	126, 125
Six-cent .....	32, 325	25, 905	34, 570	32, 785	125, 585
Eight-cent .....	14, 920	12, 515	20, 940	16, 440	64, 815
Nine-cent .....	5, 920	3, 630	6, 680	6, 420	22, 650
Ten-cent .....	31, 520	32, 500	44, 320	38, 070	146, 410
Twelve-cent .....	20, 770	22, 555	25, 995	24, 580	93, 900
Twenty-four cent .....	16, 830	18, 335	22, 925	22, 960	81, 050
Thirty-six-cent .....	8, 025	9, 250	11, 875	11, 105	40, 255
Forty-eight-cent .....	6, 975	8, 065	10, 260	9, 565	34, 865
Sixty-cent .....	6, 025	6, 475	10, 530	9, 220	32, 310
Seventy-two-cent .....	2, 430	2, 550	5, 825	4, 915	15, 720
Eighty-four-cent .....	2, 790	3, 185	5, 045	4, 570	15, 590
Ninety-six-cent .....	11, 460	9, 940	11, 300	10, 695	43, 395
One-dollar-and-ninety-two-cent .....	6, 290	5, 215	7, 050	6, 415	24, 970
Three-dollar .....	6, 719	6, 319	7, 904	5, 874	26, 116
Six-dollar .....	3, 799	1, 673	3, 682	2, 921	12, 075
Nine-dollar .....	2, 571	1, 434	1, 781	1, 576	7, 352
Twelve-dollar .....	2, 219	1, 672	2, 078	1, 884	7, 853
Twenty-four-dollar .....	1, 636	404	528	762	3, 390
Thirty-six-dollar .....	529	515	439	618	2, 101
Forty-eight-dollar .....	333	96	232	513	1, 174
Sixty-dollar .....	691	648	807	900	3, 046
Value .....	\$261, 974 55	\$184, 949 80	\$243, 701 90	\$254, 628 50	\$945, 254 75
<i>Ordinary stamped envelopes.</i>					
One-cent .....	3, 962, 500	5, 297, 500	5, 217, 750	4, 911, 250	19, 389, 000
Two-cent .....	555, 500	1, 191, 000	830, 500	753, 000	3, 330, 000
Three-cent .....	13, 580, 400	15, 116, 000	15, 057, 500	15, 574, 600	59, 328, 500
Five-cent .....	171, 750	96, 000	41, 250	21, 250	360, 250
Six-cent .....	21, 700	58, 600	46, 900	29, 750	156, 950
Ten-cent .....				1, 250	1, 250
Fifteen-cent .....				350	350
Thirty-cent .....			100	250	350
Ninety-cent .....			100	250	350
One-cent wrappers .....	2, 894, 250	3, 031, 250	3, 412, 250	2, 577, 250	11, 915, 000
Two-cent wrappers .....	1, 683, 750	1, 575, 000	1, 567, 000	1, 698, 000	6, 533, 750
Value .....	\$583, 514 33	\$659, 022 95	\$659, 165 59	\$659, 339 44	\$2, 554, 049 24
<i>Stamped envelopes bearing a request to return letter.</i>					
One-cent .....	378, 000	475, 000	405, 500	322, 000	1, 640, 500
Two-cent .....	417, 000	542, 500	523, 500	529, 000	2, 012, 000
Three-cent .....	14, 132, 250	16, 020, 250	15, 413, 000	15, 139, 000	60, 704, 500
Five-cent .....	4, 000	7, 500	5, 500	2, 500	19, 500
Six-cent .....	41, 000	36, 000	57, 000	42, 500	176, 500
Fifteen-cent .....	500	500		500	1, 500
Value .....	\$422, 851 00	\$542, 993 45	\$528, 944 35	\$512, 789 50	\$2, 079, 578 30

No. 7.—*Postage-stamps, stamped envelopes, &c.*—Continued.

Description.	Quarter ending September 30, 1875.	Quarter ending December 31, 1875.	Quarter ending March 31, 1876.	Quarter ending June 30, 1876.	Total.
<i>Postal cards.</i>					
One-cent .....	30, 647, 500	41, 988, 500	40, 103, 500	38, 075, 500	150, 815, 000
Value .....	\$306, 475 00	\$419, 885 00	\$401, 035 00	\$380, 755 00	\$1, 508, 150 00
<i>Official postage-stamps.</i>					
One-cent .....	449, 700	47, 000	98, 200	407, 350	1, 002, 250
Two-cent .....	268, 600	29, 400	164, 700	451, 900	914, 600
Three-cent .....	3, 108, 300	1, 890, 250	2, 722, 350	5, 528, 700	13, 249, 600
Six-cent .....	581, 150	113, 400	175, 500	960, 000	1, 830, 050
Seven-cent .....	4, 600	4, 100	6, 110	3, 300	18, 110
Ten-cent .....	28, 975	9, 100	27, 450	207, 400	272, 925
Twelve-cent .....	35, 445	10, 900	32, 410	56, 850	135, 605
Fifteen-cent .....	13, 570	4, 470	6, 070	28, 900	53, 010
Twenty-four-cent .....	10, 050	7, 650	3, 530	24, 100	45, 330
Thirty-cent .....	23, 400	6, 900	17, 840	86, 950	135, 090
Ninety-cent .....	5, 700	2, 960	6, 625	10, 310	25, 595
Two-dollar .....			500		500
Value .....	\$162, 057 40	\$74, 315 00	\$117, 610 60	\$309, 848 50	\$663, 831 50
<i>Official stamped envelopes and wrappers.</i>					
One-cent .....				200	200
Two-cent .....	102, 500	146, 000	191, 500	158, 000	596, 000
Three-cent .....	2, 393, 400	2, 957, 500	3, 241, 350	3, 629, 150	12, 251, 400
Six-cent .....	61, 900	45, 000	168, 100	67, 300	342, 300
Ten-cent .....				25	25
Twelve-cent .....				100	100
Fifteen-cent .....				20	20
Thirty-cent .....				10	10
One-cent wrappers .....	600, 000	400, 000	600, 000	900, 000	2, 500, 000
Two-cent wrappers .....	100				100
Value .....	\$84, 300 42	\$99, 353 40	\$117, 886 50	\$127, 570 61	\$429, 110 93

## RECAPITULATION.

Description.	Number.	Value.
Ordinary postage-stamps .....	698, 799, 090	\$18, 773, 454 00
Newspaper and periodical stamps .....	1, 290, 347	945, 254 75
Ordinary stamped envelopes—plain .....	82, 467, 000	2, 280, 318 74
request .....	64, 554, 500	2, 079, 578 30
Total stamped envelopes .....	147, 021, 500	4, 359, 897 04
Newspaper-wrappers .....	18, 492, 750	273, 723 50
Postal cards .....	150, 815, 000	1, 508, 150 00
Official postage-stamps .....	17, 632, 665	663, 831 50
Official stamped envelopes and wrappers .....	15, 690, 155	429, 110 93
Whole number and value of stamps, stamped envelopes, and wrappers .....	1, 049, 797, 507	26, 933, 421 72

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

OFFICIAL POSTAGE-STAMPS.

Name of Department.	NUMBER AND DENOMINATION OF STAMPS.											Amount.
	1-cent.	2-cent.	3-cent.	6-cent.	7-cent.	10-cent.	12-cent.	15-cent.	24-cent.	30-cent.	90-cent.	2-dollar.
Executive.....	2,300	3,000	5,400	2,100	5,000	2,300	1,000	1,000	1,000	1,000	.....	500
State.....	5,000	5,000	5,000	10,000	10,000	.....	.....	.....	.....	.....	.....	\$600 00
Treasury.....	550,000	300,000	1,800,000	540,000	.....	.....	.....	.....	.....	.....	.....	3,040 00
War.....	83,750	51,800	231,000	144,050	13,110	50,735	29,830	14,430	12,080	12,840	3,245	37,852 50
Navy.....	15,000	25,000	95,000	40,000	.....	10,000	10,000	5,000	4,000	4,000	2,000	14,460 00
Post-Office.....	232,300	247,300	10,435,200	745,900	.....	101,200	13,975	9,280	9,500	60,400	4,950	403,123 00
Interior.....	114,000	253,000	615,000	336,000	.....	105,900	77,500	18,500	18,250	52,250	15,000	100,960 00
Justice.....	.....	4,500	31,000	12,000	.....	3,500	3,300	1,800	500	600	400	3,476 00
Agriculture.....	.....	25,000	30,000	.....	.....	.....	.....	.....	.....	.....	.....	1,400 00
Total.....	1,002,250	914,600	13,249,600	1,830,050	18,110	272,925	132,605	53,010	45,330	135,000	25,595	500
												663,831 50

OFFICIAL STAMPED ENVELOPES AND WRAPPERS.

Name of Department.	NUMBER AND DENOMINATION OF ENVELOPES.										NEWSPAPER-WRAPPERS.		Amount.
	1-cent.	2-cent.	3-cent.	6-cent.	10-cent.	12-cent.	15-cent.	30-cent.	1-cent.	2-cent.	1-cent.	2-cent.	
War.....	200	.....	411,450	3,000	25	100	20	10	2,500,000	100	.....	.....	\$41,624 43
Post-Office.....	.....	596,000	11,839,950	339,300	.....	.....	.....	.....	.....	.....	.....	.....	387,476 50
Total.....	200	596,000	12,251,400	342,300	25	100	20	10	2,500,000	100	.....	.....	429,110 93

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

# REPORT OF THE POSTMASTER-GENERAL.

No. 9.—Statement showing the increase in the issue of postage-stamps, stamped envelopes, newspaper-wrappers, and postal cards, including the issues for official use, for the year ended June 30, 1876, over those of the preceding year.

Description.	1875.		1876.		Increase.		Per cent. increase.	
	Number.	Amount.	Number.	Amount.	Number.	Amount.	Number.	Amount.
Ordinary postage-stamps.....	682,349,470	\$18,971,479 00	698,799,000	\$18,773,454 00	16,456,630	\$501,975 00	9.41	9.74
Newspaper and periodical stamps.....	9,900,215	815,092 47	1,890,247	945,954 75	10,188,968	139,352 98	*41.50	15.85
Ordinary stamped envelopes, plain.....	72,985,140	2,046,114 35	82,457,000	9,880,318 74	10,181,860	534,907 60	14.08	11.44
..... request.....	54,631,000	1,791,686 25	64,534,500	2,079,578 30	9,623,500	287,892 05	18.16	16.06
Newspaper-wrappers.....	24,830,250	1,826,679 74	18,498,750	273,723 50	*4,351,500	*12,856 24	*18.04	*4.50
Postal cards.....	107,616,000	1,076,160 00	150,615,000	1,506,150 00	43,199,000	431,990 00	40.14	40.14
Total ordinary issues.....	941,934,065	24,938,018 81	1,016,434,667	25,800,439 29	74,490,602	1,572,460 48	7.90	6.47
Add official postage-stamps.....	18,485,940	534,970 25	17,682,665	653,831 50	*813,275	*171,138 75	*4.39	*20.49
Add official stamped envelopes and wrappers.....	12,845,000	354,582 16	15,690,155	429,110 93	2,845,155	74,588 75	22.14	21.03
Aggregate of all issues.....	973,275,025	25,477,511 24	1,049,797,507	26,953,421 72	76,522,482	1,475,910 48	7.86	5.79

\* Decrease.

EDWARD W. BARBER,  
Third Assistant Postmaster-General.



No. 10.—Statement showing the number of dead-letters received and disposed of during the fiscal year ended June 30, 1876.

Description.	Received.		Delivered.		Filed.		Outstanding.		Destroyed.	Awaiting return of notice.	Treated as ordinary.	Opened after 30 days and returned to writer.
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Number.	Number.	Number.
Containing money from last fiscal year.....	9, 872	\$13, 244 72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Containing money received during the year.....	25, 740	41, 447 17	92, 709	\$36, 376 16	6, 737	\$6, 490 45	6, 166	\$11, 895 28	.....	.....	.....	.....
Containing drafts, bills of exchange, &c., from last fiscal year.....	655	130, 963 84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Containing drafts, bills of exchange, &c., received during the year.....	12, 889	1, 754, 648 31	12, 321	1, 715, 970 06	507	70, 684 90	716	98, 957 89	.....	.....	.....	.....
Total.....	49, 156	1, 939, 604 04	35, 030	1, 751, 648 22	7, 244	77, 104 65	6, 882	110, 853 17	.....	.....	.....	.....
Containing jewelry and other property, received.....	20, 367	.....	10, 982	.....	9, 377	.....	8	.....	.....	.....	.....	.....
Containing receipts, bills of lading, &c., received.....	25, 788	.....	22, 739	.....	3, 049	.....	.....	.....	.....	.....	.....	.....
Containing photographs, received.....	31, 318	.....	23, 497	.....	7, 881	.....	.....	.....	.....	.....	.....	.....
Containing postage-stamps, received.....	37, 054	.....	29, 234	.....	7, 820	.....	.....	.....	.....	.....	.....	.....
Ordinary letters without inclosures, from last fiscal year.....	24, 000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ordinary letters received during the year.....	2, 885, 979	.....	1, 069, 307	.....	.....	.....	25, 200	.....	{ 11, 647, 194	.....	.....	.....
Foreign letters from last fiscal year.....	7, 723	.....	.....	.....	.....	.....	.....	.....	{ 188, 378	.....	.....	.....
Foreign letters received during the year.....	195, 800	.....	200, 434	.....	.....	.....	3, 069	.....	.....	.....	.....	.....
Hold-for-postage letters.....	307, 559	.....	6903, 903	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	*3, 594, 744	.....	1, 594, 496	.....	35, 311	.....	15, 179	.....	1, 835, 472	15, 900	20, 255	68, 301

\* Classified as follows: Ordinary mail letters, 2,355,194; drop, or local, 445,000; returned from foreign countries, (domestic origin,) including circulars, &c., 108,692; returned from hotels, 45,136; held for postage, 307,559; misdirected, 69,797; with no address, 6,945; ship and steamboat letters, (i. e., brought by sea outside the mails,) 2,884; registered, 5,347; foreign origin, (including circulars, &c.), 195,800; and outstanding and not acted upon from last fiscal year, 10,527; foreign origin, 7,723; and ordinary letters, (unopened,) 24,000 from last fiscal year.

† Letters which could not be returned, circulars, &amp;c.

‡ Returned unclaimed a second time.

a On hand unopened July 1, 1876.

b Forwarded to address upon receipt of postage.

c Addressed to foreign countries, misdirected, &amp;c.

EDWARD W. BARBER,

Third Assistant Postmaster-General.

No. 11.—Statement showing the classification and disposition of letters containing valuable inclosures for the fiscal year ended June 30, 1876.

	Delivered.	Filed for reclamation.	Outstanding in hands of postmasters.	Total.
Money.....	22,709	6,737	6,166	35,612
Called "Minor":				
Checks, drafts, bills of exchange, letters of credit, certificates of stock.....	7,092	292	410	7,794
Money-orders, foreign and domestic.....	3,384	140	196	3,730
Notes and due-bills.....	1,068	44	62	1,174
Deeds and land-warrants.....	406	17	24	447
Mortgages and assignments, releases, satisfaction of, &c.....	80	3	5	88
Leases and assignments of, &c.....	2		1	3
Passage and railroad tickets.....	248	11	14	273
Bank-books.....	14		2	16
Pension-certificates.....	17		2	19
Called "Sub-Minor":				
Receipts, bills of lading.....	11,734	1,318		13,052
Legal documents.....	2,307	126		2,433
Sealed foreign letters inclosed.....	1,551	237		1,788
Sealed domestic letters inclosed.....	261	90		351
Pension-papers, registered-letter receipts, &c.....	282	14		296
Locks of hair.....	1,668	477		2,145
Paid notes, cancelled checks, &c.....	686	35		721
Photographs.....	23,497	7,891		31,318
Postage-stamps.....	33,512	3,542		37,054
Miscellaneous.....	5,260	752		6,012
Called "Property":				
Jewelry.....	959	648	6	1,613
Dry-goods and clothing.....	1,127	1,145		2,272
Books, pictures, and music.....	3,520	2,195		5,715
Merchandise and samples.....	2,054	2,275		4,329
Cutlery and instruments.....	131	102		233
Manuscripts.....	220	219		439
Miscellaneous.....	2,971	2,793	2	5,766
	126,770	31,033	6,890	164,693

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

No. 12.—Statement showing number, contents, and disposition of registered letters received during the fiscal year ended June 30, 1876.

	Delivered.	Filed.	Outstanding or not acted upon.	Total.
Money-letters, including 56 from last fiscal year.....	649	50	63	762
Minor letters:				
Drafts, including 1 from last fiscal year.....	140	24	1	165
Money-orders.....	5	2		7
Notes.....	6			6
Bank-books.....	1			1
Passage-tickets.....	15	2		17
Deeds.....	1	1		2
Sub-minor letters:				
Photographs.....	43	12		55
Receipts.....	9			9
Powers of attorney.....	11	1		12
Stamps.....	8	1		9
Miscellaneous.....	85	2		87
Property-letters and packages:				
Jewelry, including 2 from last fiscal year.....	44	13	6	63
Merchandise, including 7 from last fiscal year.....	41	10	2	53
Without valuable inclosures.....	490	127		617
Foreign letters, including 135 from last fiscal year.....	3,874		9	3,883
	5,422	245	81	5,748

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

No. 13.—Number of registered letters transmitted through the mails from each State and Territory in the United States during the fiscal year ended June 30, 1876.

States and Territories.	Quarter ended Septem- ber 30, 1875.			Quarter ended Decem- ber 31, 1875.			Quarter ended March 31, 1876.			Quarter ended June 30, 1876.			Total.		Grand total of let- ters registered for year ended June 30, 1876.	Fees received.
	Domestic.	Foreign.	Free.	Domestic.	Foreign.	Free.	Domestic.	Foreign.	Free.	Domestic.	Foreign.	Free.	Domestic.	Foreign.		
Alabama.....	6,553	45	993	8,980	56	1,186	11,132	73	1,437	9,661	69	1,676	35,565	943	5,302	\$3,570 80
Arkansas.....	4,947	20	636	7,147	41	819	9,327	55	1,548	8,647	135	1,786	30,068	251	2,766	31,085
California.....	17,045	3,482	1,292	22,097	4,267	1,465	21,262	3,642	1,274	20,619	335	1,311	81,016	14,726	5,212	9,574 20
Colorado.....	6,185	137	807	6,358	197	753	6,672	149	417	6,752	141	3,113	25,977	624	2,030	26,601
Connecticut.....	9,189	560	28,946	10,964	723	28,507	12,390	634	35,291	10,825	490	33,412	43,308	2,407	130,356	4,571 50
Delaware.....	1,340	56	1,390	1,390	18	143	1,571	18	65	1,517	16	70	5,018	59	2,334	6,211
Florida.....	4,453	23	594	4,453	104	463	5,992	53	1,064	5,711	37	582	19,446	138	9,101	1,982 40
Georgia.....	10,377	63	1,556	13,410	105	1,697	16,572	91	1,664	13,787	54	1,553	33,146	313	6,480	5,345 90
Illinois.....	44,010	2,237	6,371	56,280	486	7,258	67,745	504	6,400	59,557	971	7,111	297,592	9,309	27,040	293,934
Indiana.....	25,694	253	2,534	33,396	268	3,955	43,478	293	3,934	35,481	293	3,277	137,969	1,064	11,700	150,073
Iowa.....	29,673	291	4,297	36,970	431	4,447	44,357	550	4,534	37,952	403	4,690	148,952	1,675	17,998	168,635
Kansas.....	11,132	66	1,531	14,355	126	1,816	18,707	142	1,920	16,648	102	1,740	60,398	1,446	7,007	68,391
Kentucky.....	10,991	118	1,016	12,304	154	1,268	16,041	130	1,127	16,085	106	905	55,394	498	4,215	5,582 20
Louisiana.....	8,592	419	769	11,639	524	767	15,635	701	781	13,029	550	975	45,825	2,198	3,219	50,337
Maine.....	15,873	463	1,359	19,599	547	1,408	22,436	507	1,085	17,015	454	669	69,923	1,691	4,403	76,717
Maryland.....	8,445	409	670	9,559	415	1,603	11,099	494	1,589	9,636	354	692	32,763	1,000	4,909	4,038 70
Massachusetts.....	27,969	3,503	12,983	39,518	4,341	15,592	30,023	3,434	15,691	28,413	3,172	14,744	111,163	14,680	52,980	124,604
Michigan.....	17,613	1,550	3,404	23,465	1,746	4,077	36,638	1,598	3,520	35,918	1,474	3,043	123,982	6,358	12,964	134,604
Minnesota.....	17,060	338	1,096	20,410	543	9,014	26,927	603	1,768	19,629	411	2,394	74,705	1,992	6,688	81,965
Mississippi.....	28,112	534	1,340	33,457	646	1,535	42,035	305	2,683	38,216	631	1,686	140,676	2,315	9,811	150,043
Missouri.....	28,112	534	1,340	33,457	646	1,535	42,035	305	2,683	38,216	631	1,686	140,676	2,315	9,811	150,043
Montana.....	3,447	147	908	3,447	147	908	3,447	147	908	3,447	147	908	3,447	147	908	4,313 40
Nebraska.....	2,606	628	240	3,170	604	326	4,284	636	730	3,546	356	383	13,943	2,710	2,986	14,929 10
New Hampshire.....	7,785	321	601	9,953	325	793	9,953	325	793	9,953	325	793	33,565	1,406	2,669	36,347
New Jersey.....	11,633	941	30,338	15,151	1,223	794	103,402	13,432	46,969	93,449	18,286	3,070	379,335	53,063	170,061	624,469
New York.....	94,333	12,665	1,924	115,630	1,636	1,688	18,226	67	1,951	17,077	916	5,173	104,956	4,383	21,577	126,558
North Carolina.....	13,879	10	5,371	15,630	1,201	5,446	61,916	3,302	3,382	52,302	32	3,069	16,286	136	1,404	18,476
Ohio.....	39,437	962	3,394	45,113	37	359	5,321	1,304	2,365	3,933	22	3,344	14,818	10,806	12,391	27,940
Oregon.....	5,367	62	692	6,090	542	1,032	4,005	47	1,147	3,532	367	1,146	14,713	1,921	5,563	16,732
Pennsylvania.....	51,812	3,259	3,067	58,138	743	1,392	6,329	89	787	8,782	85	602	32,925	3,311	2,890	36,056
Rhode Island.....	3,343	138	669	4,119	49	762	9,329	113	1,271	7,706	129	1,292	35,679	414	5,102	37,609 30
South Carolina.....	6,525	75	1,290	12,621	97	1,259	16,330	113	1,292	15,025	439	1,164	77,349	1,532	7,006	81,935
Tennessee.....	13,952	350	1,866	18,380	493	1,716	23,992	565	1,914	21,025	434	1,930	46,963	1,490	3,928	51,701
Texas.....	10,079	480	1,355	15,695	136	1,323	18,187	194	1,136	16,797	46	1,409	64,542	4,332	5,203	70,177
Vermont.....	13,863	96	1,355	15,695	136	1,323	18,187	194	1,136	16,797	46	1,409	64,542	4,332	5,203	70,177
Virginia.....	13,863	96	1,355	15,695	136	1,323	18,187	194	1,136	16,797	46	1,409	64,542	4,332	5,203	70,177
West Virginia.....	7,634	451	9,000	50	50	2,921	10,405	43	3,049	9,353	37	556	36,492	190	2,004	38,746
Wisconsin.....	24,446	747	2,924	36,309	911	2,921	36,455	692	3,049	33,925	610	3,000	131,162	3,160	11,902	146,197
Alaska.....	56						67			5			162	2		16

No. 13.—Number of registered letters transmitted through the mails, &amp;c.—Continued.

States and Territories.	Quarter ended September 30, 1875.			Quarter ended December 31, 1875.			Quarter ended March 31, 1876.			Quarter ended June 30, 1876.			Total.		Grand total of letters registered for year ended June 30, 1876.	Fees received.
	Domestic.	Foreign.	Free.	Domestic.	Foreign.	Free.	Domestic.	Foreign.	Free.	Domestic.	Foreign.	Free.	Domestic.	Foreign.		
Arizona .....	884	1	53	1,235	9	53	1,543	4	70	1,113	6	74	4,785	90	5,053	\$480 50
Delaware .....	1,711	31	131	2,501	64	165	2,905	57	944	2,498	54	174	9,546	208	10,466	975 30
District of Columbia .....	4,317	940	14,879	5,119	1,108	16,173	5,367	993	13,950	4,754	977	12,675	19,557	4,098	81,260	358 30
Idaho .....	1,677	36	19	1,998	37	79	1,735	99	96	1,765	94	94	7,176	136	7,446	730 30
Indian .....	993	13	53	1,166	7	141	1,410	11	53	1,165	7	59	4,644	38	4,911	468 20
Montana .....	1,810	14	179	2,175	39	141	2,398	35	187	1,945	90	166	8,936	108	9,047	833 40
New Mexico .....	2,392	8	48	1,634	5	71	1,942	11	198	1,957	8	113	7,895	39	8,009	785 70
Utah .....	2,280	76	953	2,913	51	983	4,861	87	529	4,038	69	596	16,199	976	17,439	1,639 80
Washington .....	1,495	60	131	1,943	58	198	2,461	58	131	1,994	69	197	7,733	945	8,493	797 80
Wyoming .....	2,139	90	212	2,590	30	228	2,212	30	134	2,370	24	154	9,331	104	10,163	943 50
Total .....	648,171	36,333	159,573	803,355	42,938	165,928	916,436	40,157	170,669	830,969	35,806	164,488	3,193,931	155,285	4,007,817	335,416 60

## RECAPITULATION.

Total domestic.....	3,198,931
Total foreign.....	155,285
Total free.....	653,651
Grand total .....	4,007,817
Total fees received.....	\$335,416 60

EDWARD W. BARBER,  
Third Assistant Postmaster-General.

CONTRACT-OFFICE, POST-OFFICE DEPARTMENT,  
*Washington, D. C., November 11, 1876.*

SIR: For a statement of the mail-service for the contract-year ended June 30, 1876, &c., I have the honor to refer you to the tables hereto annexed.

Table A exhibits the character of the service, the length of routes, the number of miles of transportation, and the cost thereof at the close of the contract-year.

Table B exhibits the railroad-service as in operation on the 30th of June, 1876; also the cost per mile in each State and Territory.

Table C exhibits the steamboat-service as in operation on the 30th of June, 1876.

Table D shows the increase and decrease of mail-transportation and cost in the several States and Territories during the year ended June 30, 1876.

Table E shows the weight of the mails, the speed with which they are conveyed, the accommodations for mails and agents, the trips per week, and the rates of pay per mile per annum on railroad-routes in States in which the contract-term expired June 30, 1876, and also in other States and Territories, the returns having been obtained with a view to the re-adjustment of the pay in accordance with the act of March 3, 1873, and used also in accordance with the act of July 12, 1876, in the case of re-adjustments taking effect on and after July 1, 1876. This table is accompanied with an alphabetical index of the titles of the companies carrying the mails.

Table F shows the re-adjustment of the rates of pay per mile on railroad-routes in which the contract-term expired June 30, 1876, and also in other States and Territories, and on certain new routes the adjustment of the rates based upon returns of the weight of the mails, the speed with which they are conveyed, the accommodations for mails and agents, and the number of trips per week, in accordance with the act of March 3, 1873, and with the act of July 12, 1876, in the case of re-adjustments taking effect on and after July 1, 1876. This table also is accompanied with an alphabetical index of the titles of the companies carrying the mails.

Table G is a statement of the number, description, and prices of mail-bags, mail-bag-catchers, mail locks and keys purchased, and of the expense incurred on account thereof, during the fiscal year ended June 30, 1876.

Table H is a list of railway post-office lines in the United States June 30, 1876, showing the increase in the service since June 30, 1875.

Very respectfully, your obedient servant,

THOS. J. BRADY,  
*Second Assistant Postmaster-General.*

Hon. JAMES N. TYNER,  
*Postmaster-General.*

A.—Table of mail-service for the year ended June 30, 1876, as exhibited by the state of the arrangements at the close of the year.

[The entire service and pay on each route are set down to the State under which the route is numbered, though extending sometimes into other States, instead of being divided among the States in which the different portions lie.]

States and Territories.	Length of routes.	Annual transportation and cost.						Total annual trans- portation by coler- ity, certainty, and security.	Total annual trans- portation by steam- boat.	Total annual trans- portation by rail- road.	Miles.	Total annual trans- portation.	Miles.	Total annual cost.
		Celerity, certainty, and security.		By steamboat.		By railroad.								
		Miles.	Dollars.	Miles.	Dollars.	Miles.	Dollars.							
Maine.....	4,568	3,454	90,166	32	700	1,082	151,968	1,590,508	12,480	1,054,325	2,637,313	2,637,313	242,834	
New Hampshire.....	1,734	1,092	31,094	60	1,850	672	66,911	491,536	18,200	741,677	1,251,413	1,251,413	99,855	
Vermont.....	2,258	1,370	50,417	.....	.....	868	106,749	798,573	.....	678,525	1,477,098	1,477,098	157,166	
Massachusetts.....	2,968	2,147	56,001	30	2,500	1,861	316,511	639,613	12,840	2,827,817	3,480,270	3,480,270	375,012	
Rhode Island.....	568	214	9,779	198	16,000	1,066	162,048	114,972	135,969	279,513	3,480,270	3,480,270	45,062	
Connecticut.....	1,673	606	26,690	.....	.....	1,365	1,306,062	3,034,640	72,384	9,105,376	12,202,400	12,202,400	188,738	
New York.....	11,981	5,967	225,372	151	4,953	5,863	1,191,434	4,653,890	35,776	2,064,335	2,366,001	2,366,001	1,566,407	
New Jersey.....	2,313	906	33,968	41	1,883	1,365	466,514	3,937,737	46,020	6,158,907	10,141,964	10,141,964	927,305	
Pennsylvania.....	14,113	9,592	285,938	88	4,370	4,433	23,854	86,853	.....	227,523	2,872,736	2,872,736	756,882	
Delaware.....	443	175	6,304	.....	.....	268	23,353	994,233	61,360	1,817,123	1,491,616	1,491,616	30,158	
Maryland.....	3,052	1,721	67,595	190	3,750	1,141	251,333	994,233	61,360	1,817,123	2,872,736	2,872,736	392,678	
West Virginia.....	5,210	4,738	71,355	250	13,700	1,770	245,702	1,458,226	103,740	229,716	4,517,663	4,517,663	196,141	
Virginia.....	10,390	7,894	133,577	936	32,100	1,770	245,702	1,458,226	397,888	8,035,681	9,819,966	9,819,966	411,379	
North Carolina.....	10,062	8,376	96,660	348	11,389	1,338	119,965	1,458,226	95,868	2,957,421	3,473,809	3,473,809	227,974	
South Carolina.....	3,976	2,827	62,727	45	1,500	1,108	90,114	673,152	8,436	1,092,921	1,473,809	1,473,809	196,753	
Georgia.....	6,965	4,413	62,727	206	5,569	2,360	210,631	695,034	43,364	2,257,421	2,996,989	2,996,989	278,927	
Florida.....	6,002	2,900	33,497	400	55,916	2,046	183,354	98,563	457,145	1,046,376	1,192,855	1,192,855	117,976	
Alabama.....	7,966	5,940	83,755	202	4,800	1,135	120,770	853,970	54,496	1,069,540	1,978,006	1,978,006	373,572	
Mississippi.....	6,126	4,729	63,607	992	63,607	1,330	57,268	770,310	293,800	468,955	1,533,005	1,533,005	209,325	
Louisiana.....	5,215	3,701	97,851	994	92,310	1,499	57,268	9,604,868	328,703	2,225,262	9,225,262	9,225,262	217,726	
Texas.....	13,973	11,639	254,644	835	92,310	1,499	57,268	9,604,868	328,703	2,225,262	9,225,262	9,225,262	927,411	
Arkansas.....	4,094	6,719	179,246	1,164	46,000	3,874	536,945	2,632,736	53,456	3,355,359	6,158,495	6,158,495	743,040	
Missouri.....	6,605	5,292	74,496	375	26,250	1,944	162,692	1,037,900	354,016	1,397,926	2,438,672	2,438,672	344,131	
Tennessee.....	7,727	5,292	89,955	884	40,800	5,507	979,697	2,368,622	103,771	3,333,632	4,900,837	4,900,837	273,195	
Kentucky.....	12,519	6,731	162,618	281	13,800	3,079	353,246	1,198,131	.....	3,333,632	4,900,837	4,900,837	273,195	
Ohio.....	7,775	4,696	87,298	.....	.....	3,079	353,246	1,198,131	.....	3,333,632	4,900,837	4,900,837	156,115	
Indiana.....	7,775	4,696	87,298	.....	.....	3,079	353,246	1,198,131	.....	3,333,632	4,900,837	4,900,837	156,115	
Illinois.....	11,568	7,446	106,162	793	18,580	6,443	903,510	1,575,574	.....	7,309,685	8,945,259	8,945,259	440,574	
Michigan.....	9,359	5,107	137,971	.....	.....	3,899	295,194	1,633,537	184,045	4,355,508	6,173,090	6,173,090	1,009,672	
Wisconsin.....	7,945	5,965	89,739	.....	.....	2,890	295,194	1,633,537	184,045	4,355,508	6,173,090	6,173,090	1,009,672	
Iowa.....	10,757	7,194	135,245	.....	.....	3,573	373,329	1,492,488	2,600,692	2,540,310	4,586,403	4,586,403	361,444	
Minnesota.....	7,923	5,136	62,905	.....	.....	2,117	182,269	1,155,426	.....	1,678,526	2,894,962	2,894,962	508,850	
Nebraska.....	6,596	5,371	96,740	.....	.....	1,425	370,835	1,256,136	.....	1,959,349	3,307,407	3,307,407	246,434	
Nevada.....	6,596	5,371	96,740	.....	.....	1,425	370,835	1,256,136	.....	1,959,349	3,307,407	3,307,407	473,635	

Kansas .....	11,710	9,140	167,461	.....	2,570	972,778	2,322,104	.....	1,062,088	4,304,886	440,039
Nevada .....	2,234	2,065	143,405	.....	143	1,304	746,980	.....	80,161	430,161	152,109
California .....	10,439	7,397	385,010	1,012	2,080	268,021	2,574,012	255,360	1,502,015	4,334,767	710,251
Oregon .....	3,979	3,491	83,465	340	244	22,340	570,226	149,760	154,570	474,556	136,267
Washington Territory .....	3,056	1,193	39,715	1,737	106	6,336	231,968	93,536	65,494	361,418	113,064
Idaho Territory .....	1,422	1,422	87,259	.....	.....	.....	402,334	.....	.....	402,334	67,259
Montana Territory .....	1,479	1,579	97,797	.....	.....	.....	531,308	.....	.....	531,308	97,797
Dakota Territory .....	2,330	2,369	61,958	.....	61	4,918	541,104	.....	38,364	579,528	66,576
Wyoming Territory .....	648	648	23,115	.....	.....	.....	116,104	.....	.....	116,104	23,115
Utah Territory .....	3,130	2,939	985,051	.....	191	12,944	1,413,897	.....	127,932	1,541,829	597,995
Colorado Territory .....	2,907	2,468	119,943	.....	419	28,795	764,824	.....	298,467	1,063,315	146,738
Indian Territory .....	1,123	1,123	31,631	.....	.....	.....	966,819	.....	.....	966,819	31,631
New Mexico Territory .....	2,192	2,192	156,246	.....	.....	.....	680,774	.....	.....	680,774	156,246
Arizona Territory .....	2,458	2,438	84,896	.....	.....	.....	395,304	.....	.....	395,304	84,896
Total .....	281,798	194,567	5,051,541	14,883	72,346	9,543,134	54,894,003	3,704,533	77,741,172	136,989,708	15,901,140
Railway-post-office clerks .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,272,340
Route-agents .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	973,250
Mail-route messengers .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	145,610
Local agents .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	104,310
Mail-messengers .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	635,768
Aggregate .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12,361,048

THOS. J. BRADY,

Second Assistant Postmaster-General.

## B.—Railroad-service as in operation on the 30th of June, 1876.

Number of route.	State and terminl.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
	MAINE.		Miles.	Miles.		Dollars.	Dollars.	Dollars.	
1	Augusta to Skowhegan.....	Maine Central.....	22	22	18	4,610 00	.....	140 00	\$140 per annum included for mail-messenger service, \$1,050 per annum included for mail-messenger service.
2	Portland to Bangor.....	do.....	73.28	73.28	6	25,199 00	.....	90 00	
3	Newport to Dexter.....	do.....	55	55	6	840 00	.....	175 00	
4	Calais to Princeton.....	Saint Croix and Penobscot.....	14	14	12	2,100 00	.....	225 00	
5	{ Portland to Augusta..... { Branch, Brunswick to Bath.....	Maine Central.....	64	64	12	14,520 00	.....	50 00	
6	Portland to Canada Line.....	Grand Trunk.....	92	92	12	22,770 00	.....	210 00	\$420 per annum included for mail-messenger service.
7	Portland to Rochester, N. H.....	Portland and Rochester.....	73	73	6	380 00	.....	138 00	
9	Bangor to Vanceborough.....	Consolidated European and North American.....	118.25	118.25	6	20,693 75	.....	65 00	
10	Old Town to Abbot.....	do.....	54.2	54.2	6	2,981 00	.....	175 00	
11	Belfast to Burnham Village.....	Maine Central.....	34.19	34.19	12	1,846 20	.....	55 00	
12	Portland to Lunenburg Station, Vt.....	Portland and Ogdensburg.....	116.55	116.55	12	17,482 50	.....	54 00	Pay estimated on 43.7 miles. \$1,000 per annum included for mail-messenger service.
13	Bath to Rockland.....	Knox and Lincoln.....	50	50	12	6,000 00	.....	150 00	
14	Houlton to New Brunswick Line.....	New Brunswick and Canada.....	3.82	3.82	6	191 00	.....	100 00	
34	Farmington to Brunswick.....	Maine Central.....	71.5	71.5	6	5,412 50	.....	50 00	
194	Portland to Portsmouth, N. H.....	Eastern.....	44.18	44.18	18	14,716 00	.....	75 00	
381	Salmon Falls, N. H., to Portland, Me.....	Boston and Maine.....	59	59	12	5,796 62	.....	983 00	Pay estimated on 5.1 miles.
231	West Waterville to North Angon.....	Somerset.....	95.7	95.7	6	1,285 00	.....	131 35	
344	Bangor to Bucksport.....	Consolidated European and North American.....	19.35	19.35	12	1,722 15	.....	50 00	
			1,083 02	1,083 02		151,967 72	.....	69 00	
351	Concord to Nashua.....	Concord.....	36	36	18	8,100 00	.....	225 00	
	NEW HAMPSHIRE.								



228	Concord to Wells River, Vt.	32	.....	15	.....	13,100 00	.....	125 00	{ \$1,410 per annum included for mail-messenger service.
229	{ Concord to White River Junction, Vt.	{ 42	.....	{ 12	.....	.....	.....	{ 190 00	{ \$1,150 per annum included for mail-messenger service.
230	{ Branch, Franklin to Bristol, Vt.	{ 60	.....	{ 6	.....	14,910 00	.....	{ 50 00	{ \$400 per annum included for mail-messenger service.
231	Concord to Claremont Junction.....	34 99	.....	12	.....	6,908 80	.....	130 00	
232	Concord to Portsmouth.....	60	.....	12	.....	3,600 00	.....	60 00	
233	Manchester to North Weare.....	20 5	.....	6	.....	1,025 00	.....	50 00	
234	Nashua to Greenfield.....	27	.....	12	.....	1,755 00	.....	65 00	
235	Contecook Village to Hillsborough Bridge.....	15	.....	6	.....	750 00	.....	50 00	
236	Dover to Alton Bay.....	28	.....	6	.....	1,400 00	.....	50 00	
237	Brook's Crossing to North Conway.....	6	.....	12	.....	4,256 60	.....	60 00	
238	Groton to Wells River, Vt.....	64 11	.....	12	.....	4,860 00	.....	90 00	
239	Rosket to Pittsfield.....	20	.....	11	.....	1,000 00	.....	30 00	
240	Wolfborough Junction to Wolfborough.....	12 11	.....	6	.....	383 30	.....	30 00	
241	Nashua to Acton.....	23 44	.....	6	.....	937 60	.....	40 00	
242	Wing Road to Fabian House.....	13 65	.....	6	.....	749 50	.....	50 00	
243	Portsmouth to Dover.....	11 64	.....	6	.....	589 00	.....	50 00	
244	Nashua to Rochester.....	49 40	.....	6	.....	2,470 00	.....	50 00	
			672 04				66,910 80		
VERMONT.									
401	Burlington to Rouse's Point, N. Y.	34 5	.....	15	.....	10,415 00	.....	210 00	
402	White River Junction to Derby Line.	114 87	.....	6	.....	20,108 25	.....	170 00	
403	{ Windsor to Burlington.....	{ 93	.....	{ 15	.....	25,240 00	.....	{ 218 00	
404	{ Branch, Montpelier to Barre.....	{ 26	.....	{ 6	.....	.....	.....	{ 178 00	
405	Bellows Falls to Windoor.....	25	.....	12	.....	5,125 00	.....	50 00	
406	Bellows Falls to Burlington.....	53	.....	6	.....	20,449 00	.....	205 00	
407	Brattleborough to Bellows Falls.....	67 5	.....	12	.....	4,920 00	.....	157 00	
408	Saint Albans to Canada Line.....	24	.....	18	.....	1,445 00	.....	152 00	
409	Saint Albans to Richford.....	17	.....	12	.....	2,149 50	.....	205 00	
410	Lunenburg Junction to Johnson.....	28 66	.....	6	.....	9,851 25	.....	85 00	
411	Richford to Newport.....	74 81	.....	6	.....	3,138 00	.....	75 00	
412	Leicester Junction to Ticonderoga Station.....	31 38	.....	6	.....	1,450 00	.....	185 00	
413	Wells River to Montpelier.....	38 62	.....	6	.....	1,737 90	.....	100 00	
414	White River Junction to Woodstock.....	14 53	.....	6	.....	726 50	.....	100 00	
			688 13				106,749 40		

B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
MASSACHUSETTS.									
601	Boston to Portsmouth, N. H.	Eastern.	56.5	.....	24	16,667 50	.....	295 00	
602	{ Boston to Salmon Falls, N. H. Branch, Hollingsford to Great Falls.	Boston and Maine	{ 71.16 3	.....	{ 12 12	{ 13,901 67	.....	{ 193 25 50 00	
603	Boston to Nashua, N. H.	Boston and Lowell and Nashua	42	.....	18	9,660 00	.....	230 00	
604	Boston to Fitchburgh.	Fitchburgh	52	.....	18	11,440 00	.....	290 00	
605	Boston to Albany, N. Y.	Boston and Albany	{ 101 102	.....	{ 96 12	{ 109,123 00	.....	{ 640 00 396 50	
606	Boston to Bellingham.	New York and New England	31.77	.....	15	2,166 90	.....	00 00	\$260 per annum included for mail-messenger service.
607	Boston to Southbridge.	do.	70	.....	12	7,560 00	.....	106 00	
608	Boston to Providence, R. I.	Boston and Providence	{ 23 21	.....	{ 24 12	{ 6,776 00	.....	154 00	
609	{ Boston to Plymouth. Branch, Atlantic to West Quinoy }	Old Colony	{ 11.28 26.72	.....	{ 42 12	{ 6,767 50	.....	{ 150 00 50 00	\$495 per annum included for mail-messenger service.
610	Boston to Medford.	Boston and Maine.	5.5	.....	6	335 00	.....	50 00	\$60 per annum included for mail-messenger service.
615	Boston to West Lynn Depot.	Eastern.	10	.....	12	500 00	.....	50 00	
616	Boston to Dedham.	Boston and Providence.	11	.....	12	550 00	.....	50 00	
617	Grafton Depot to Millbury.	Boston and Albany	4	.....	12	300 00	.....	50 00	
618	Salem to Gloucester.	Eastern.	16	.....	18	1,072 00	.....	67 00	
619	Salem to Marblehead.	do.	4	.....	12	200 00	.....	50 00	
620	Salem to Lawrence.	do.	20	.....	6	800 00	.....	40 00	
621	Georgetown to Haverhill.	Boston and Maine	6.5	.....	12	325 00	.....	50 00	
622	Lawrence to Manchester, N. H.	Manchester and Lawrence.	28	.....	18	4,564 00	.....	163 00	
623	Lowell to Lawrence.	Boston and Lowell and Nashua and Lowell.	14	.....	21	1,050 00	.....	50 00	\$350 per annum included for mail-messenger service.
624	Winchester to Woburn.	do.	3	.....	12	150 00	.....	50 00	
625	Somerville Station to Concord.	do.	15.96	.....	12	798 00	.....	50 00	
626	South Acton Depot to Hudson.	Fitchburgh	9	.....	12	500 00	.....	50 00	
627	Ayer to Lowell.	Boston and Lowell and Nashua and Lowell.	17	.....	15	850 00	.....	50 00	\$50 per annum included for mail-messenger service.
628	Ayer to Greenville, N. H.	Fitchburgh	23	.....	19	1,437 50	.....	63 50	

6229	Auburn Station to Newton Lower Falls.	Boston and Albany	2	6	100 00	50 00	
630	Natick to Saxtonville.	do	4	12	300 00	50 00	
631	South Framingham to Pratt's Junction.	Boston, Clinton and Fitchburg	29	18	2,610 00	90 00	
632	South Framingham to Milford	Boston and Albany	12	24	1,020 00	60 00	\$300 per annum included for mail-messenger service.
633	Canton Depot to Stoughton	Boston and Providence	4	12	250 00	50 00	\$50 per annum included for mail-messenger service.
634	South Braintree Junction to New- port, R. I.	Old Colony	61.75	12	9,575 00	140 00	\$930 per annum included for mail-messenger service.
635	South Abington to Bridgewater.	do	7.75	6	390 00	40 00	\$80 per annum included for mail-messenger service.
636	Braintree Depot to Cohasset.	South Shore.	12	12	1,400 00	55 00	\$704 per annum included for mail-messenger service.
637	Middleborough to Hyannis	Old Colony	47	12	8,191 00	153 00	\$1,000 per annum included for mail-messenger service.
638	Yarmouth Port to Provincetown.	do	45.08	12	9,319 44	118 00	\$1,000 per annum included for mail-messenger service.
639	New Bedford to West Wareham.	New Bedford	16.25	15	1,093 75	50 00	\$241.25 per annum included for mail-messenger service.
640	Taunton to Middleborough	Old Colony	10.54	30	527 00	50 00	\$600 per annum included for mail-messenger service.
641	Taunton to Mansfield Junction	New Bedford	12	364	2,100 00	125 00	\$612.50 per annum included for mail-messenger service.
642	Taunton to New Bedford	do	20.05	27	3,339 00	133 00	\$600 per annum included for mail-messenger service.
643	Worcester to Nashua, N. H.	Worcester and Nashua	46.25	18	4,948 75	107 00	
644	Sterling Junction to Fitchburg	Boston, Clinton and Fitchburg	14	18	1,360 00	90 00	
645	Fitchburg to Bellows Falls, Vt.	Cheshire	64	18	10,340 00	160 00	
646	Branch, Greenfield to Turner's Falls.	Fitchburg	{ 69 18 6 }	{ 6 6 6 }	{ 14,880 00 160 00 160 00 }	{ 170 00 160 00 50 00 }	
647	Palmer to Miller's Falls	Central Vermont	5	12	3,500 00	100 00	
648	Springfield to South Vernon Junction, Vt.	Connecticut River	35 50	12 15	11,800 00	230 00	\$300 per annum included for side supply of Chicopee Falls.
649	South Vernon Junction, Vt., to Keene, N. H.	Cheshire	24	12	1,500 00	62 50	
650	Pittsfield to North Adams	Boston and Albany	21	18	1,575 00	60 00	\$315 per annum included for mail-messenger service.
651	Gloucester to Pigeon Cove	Eastern.	6.5	12	450 00	50 00	\$125 per annum included for mail-messenger service.
652	Wakefield to Newburyport	Boston and Maine	30.5	12	1,525 00	50 00	
653	South Braintree Junction to Fall River.	Old Colony	34	12	2,700 00	50 00	
654	East Salisbury to Amesbury	Eastern.	4	12	250,000	50 00	\$1,000 per annum included for mail-messenger service.
655	Palmer to Winchendon	Boston and Albany	{ 15.75 7.96 25.54 }	{ 24 18 12 }	{ 2,462 50 50 00 1,330 00 }	50 00	\$50 per annum included for mail-messenger service.
656	Mansfield to South Framingham	Boston, Clinton and Fitchburg.	22	6	1,330 00	60 00	

B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
<b>MASSACHUSETTS—Continued.</b>									
657	Winchendon to Peterborough, N. H.	Boston, Barre and Gardner, lessees of Monadnock Railroad.	16.37	.....	6	1,178 64	.....	72 00	\$150 per annum included for mail-messenger service.
658	Springfield to Athol Depot.....	Springfield, Athol and Northeastern.	49.98	.....	6	2,998 86	.....	57 00	
659	South Framingham to Lowell.....	Boston, Clinton and Fitchburg.....	59	.....	12	1,798 00	.....	62 00	
660	Worcester to Winchendon.....	Boston, Barre and Gardner.....	37	.....	12	3,237 50	.....	87 50	
661	Holyoke to Westfield.....	New Haven and Northampton.....	10.53	.....	12	528 50	.....	50 00	
662	Millford to Bellingham Junction.....	Providence and Worcester.....	5	.....	13	250 00	.....	50 00	
736	Millford to Ashland.....	do.....	11.68	.....	6	584 00	.....	50 00	
737	Cohasset Narrows to Wood's Hole.....	Old Colony.....	17.67	.....	6	1,311 51	.....	53 00	\$375 per annum included for mail-messenger service.
741	Wenham to Essex.....	Eastern.....	5.53	.....	6	277 50	.....	50 00	
742	Lynn to Marblehead.....	do.....	6.05	.....	6	392 50	.....	50 00	
743	Wakefield to Peabody.....	do.....	8.54	.....	6	427 00	.....	50 00	
744	Miller's Falls to Brattleborough, Vt.....	Central Vermont.....	21	.....	18	3,937 50	.....	187 50	
745	Newton Junction to Merrimac.....	Boston and Maine.....	5.05	.....	6	372 50	.....	50 00	\$120 per annum included for mail-messenger service.
746	Taunton to Attleborough.....	New Bedford.....	16.67	.....	28	1,250 25	.....	75 00	
747	Cohasset to Kingston.....	Duxbury and Cohasset.....	20.88	.....	6	1,044 00	.....	50 00	
753	Ashburnham Depot to Ashburnham.....	Ashburnham.....	2.89	.....	6	144 50	.....	50 00	
754	New Bedford to Fall River.....	Fall River.....	15	.....	6	750 00	.....	50 00	
755	North Brookfield to East Brookfield.	Boston and Albany, lessees of North Brookfield Railroad.	4.41	.....	6	220 50	.....	50 00	Pay estimated.
				1,861.39			316,511 07		
<b>RHODE ISLAND.</b>									
801	Providence to Worcester, Mass.....	Providence and Worcester.....	44	.....	15	6,340 00	.....	110 00	\$1,500 per annum included for mail-messenger service.
802	Providence to New London, Conn.....	Stonington and Providence.....	63.75	.....	22½	9,243 75	.....	145 00	
803	Providence to Bristol.....	Providence, Warren and Bristol.....	14.6	.....	12	1,926 00	.....	60 00	\$1,050 per annum included for mail-messenger service.
804	Warren to Fall River, Mass.....	Fall River, Warren and Providence.....	7	.....	12	420 00	.....	60 00	
823	Providence to Pascoag.....	Providence and Spring.....	93.19	.....	6	1,156 00	.....	50 00	

885	Wickford Landing to Wickford Junction.	CONNECTICUT.	3.4	153.87	154	107.20	19,938 95	58 00	
901	Norwich to Worcester, Mass.....		60		12	5,100 00		85 00	
902	New London to Palmer, Mass.....		{ 30		23	7,800 00		130 00	\$250 per annum included for mail-messenger service.
903	Middletown to Berlin Depot.....		{ 35		18	770 00		52 00	
904	New Haven to New London.....		50		23	8,817 00		175 00	
905	{ New Haven to Springfield, Mass } { Branch, Windsor Locks to Suffield, Conn. }		{ 63.833 } { 4.76 }		{ 34 } { 12 }	31,963 16		{ 497 00 } { 50 00 }	\$250 per annum included for mail-messenger service.
906	{ New Haven to Williamsburgh, Mass. }		{ 85.48 }		{ 12 }	14,504 80		{ 160 00 } { 50 00 }	
907	{ Branch, Farmington to New Hartford. }		{ 16.56 }		{ 12 }			{ 50 00 }	
	New Haven to New York.....		76.333		31	45,418 33		595 00	
908	{ Bridgeport to Winsted } { Branch, Waterbury to Watertown. }		{ 62 } { 5.75 }		{ 14 } { 12 }	7,753 50		{ 118 00 } { 50 00 }	{ \$50 per annum included for mail-messenger service.
909	{ Bridgeport to Pittsfield, Mass. }		{ 110.55 }		{ 12 }			{ 96 00 }	
	{ Branch, Van Deusenville to State Line. }		{ 11.06 }		{ 6 }	11,338 30		{ 50 00 }	
	Branch, Danbury to Brookfield Junction.		5.75		6			30 00	
910	{ South Norwalk to Danbury. }		{ 23.5 }		{ 244 }			{ 110 00 }	{ \$268.75 per annum included for mail-messenger service.
	{ Branch, Branchville to Ridgefield. }		{ 4 }		{ 12 }	3,065 50		{ 50 00 }	
	Branch, Bethel to Hawleyville.		6.01		12			50 00	
911	{ Waterbury to Providence, R. I. }		122.5		224	9,800 00		80 00	{ \$268.75 per annum included for mail-messenger service.
912	{ Vernon Depot to Rockville. }		{ 4.625 }		{ 18 }	500 00		{ 50 00 }	
	{ Side-supply of Vernon. }								
913	New Haven to Willimantic.....		24		12	2,800 00		50 00	{ \$96 per annum included for mail-messenger service. Pay estimated.
914	Hartford to Saybrook Point.....		32		6			50 00	
915	New Haven to Ansonia.....		43.16		12	2,589 60		60 00	
916	Hartford to Milford, N. Y.....		13.5		12	742.50		55 00	{ \$96 per annum included for mail-messenger service. Pay estimated.
917	Litchfield to Hawleyville.....		69.18		94	3,459 00		50 00	
918	East Thompson to Willimantic.....		32.35		12	1,935 00		60 00	
919	East Thompson to Willimantic.....		33.68		6	2,116 80		60 00	{ \$96 per annum included for mail-messenger service. Pay estimated.
920	Hartford to Springfield, Mass.....		31.1		6	1,555 00		50 00	
921							162,048 49		

## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
NEW YORK.									
1201	New York to Dunkirk	Erie	66	66	25½	122,948 00	122,948 00		{ 332 miles, at \$292. 127 miles, at \$252.
1202	Suffern to Piermont	do	393	393	19½	900 00	900 00	50 00	
1203	Buffalo to Suspension Bridge	do	18	18	6	1,686 10	1,686 10	65 00	
1204	Newburgh to Chester	do	25.94	25.94	13				
	{ Branch, Vall's Gate to Junction with main stem.	do	19.75	19.75	12	1,921 25	1,921 25	65 00	
1205	Rochester to Avon	do	18	18	12	1,440 00	1,440 00	50 00	
1206	Avon to Danville	do	30.73	30.73	12	1,843 80	1,843 80	80 00	
1207	Attica to Corning	do	111	111	12	30,525 00	30,525 00	60 00	
1208	Buffalo to Horseville	do	91	91	19½	12,103 00	12,103 00	275 00	
1209	Groton to Montgomery	do	10.25	10.25	22½	512 50	512 50	133 00	
1210	Groton to Pine Island	do	11	11	6	440 00	440 00	50 00	
1211	New York to Troy	New York Central and Hudson River.	144	144	54	141,240 00	141,240 00	40 00	{ 975 00 140 00 } Pay estimated.
1212	Troy to Schenectady	do	6	6	54	1,804 00	1,804 00	140 00	
1213	Syracuse to Rochester	do	92	92	18	15,600 00	15,600 00	82 00	
1214	Cambridge to Niagara Falls	do	104	104	24	7,215 00	7,215 00	75 00	
1215	Buffalo to Lockport	do	97	97	12	2,115 00	2,115 00	73 00	
1216	Buffalo to Lewiston	do	83	83	6	303,364 00	303,364 00	1,018 00	Do.
1217	Albany to Buffalo	do	298	298	34	13,050 00	13,050 00	214 00	Old rate of pay.
1218	Rochester to Niagara Falls	do	76	76	24	9,677 50	9,677 50	133 00	
1219	New York to Chatham Village.	New York and Harlem	130.5	130.5	6	832 00	832 00	133 00	
1221	Eagle Bridge to Rutland, Vt.	Delaware and Hudson Canal Company.	51	51	12	30,919 36	30,919 36	52 00	
1223	Schenectady to Ballston	do	16	16	6			100 00	
	{ Albany to Canada Line. Branch, Whitehall to Castleton, Vt.	do	189.93	189.93	17½			132 00	
1224	Branch, Albany Junction to Troy	do	6	6	6			100 00	
1225	Branch, Watertown and Ogdensburg.	Rome, Watertown and Ogdensburg.	28.5	28.5	12	1,852 50	1,852 50	75 00	
1226	Watertown to Cape Vincent	do	26	26	13	1,625 00	1,625 00	63 50	
	{ Rome to Ogdensburg Branch, De Kalb Junction to Norwood.	do	72.62	72.62	18	21,158 50	21,158 50	138 00	
1227		do	69.38	69.38	12			138 00	
		do	25	25	6			63 50	

Year	Location	Delaware, Lackawanna and West- ern.	30. 09	12	1, 841 40	60 00
1928	Chenango Forks to Norwich.....			12		
1929	Utica to Norwich.....		54. 5	12	4, 390 00	80 00
1930	Oswego to Ithaca.....		35	12	2, 800 00	80 00
1931	Chenango Junction to Ithaca Spring.....		91	12	1, 155 00	55 00
1932	Mincola to Locust Valley.....		19. 25	12	612 50	50 00
1933	New York to Greenport.....		32	12		
	Branch, Mincola to Hempstead		35	6		
			31	6		
			2. 5	12		
			20	12		
			16. 5	12		
1934	Hicksville to Port Jefferson.....		250. 2	6	2, 355 00	60 00
1935	Oswego to Middletown.....		8	6		
	Branch, Summit Junction to Ellenville.....		49. 21	6	12, 910 00	50 00
1938	Norwich to Cortland Village.....		13. 75	12	2, 460 50	50 00
1939	Clinton to Rome.....		16	12	687 50	50 00
1940	Walton to Delhi.....		13	12	800 00	50 00
1941	Buffalo to Chicago, Ill.....		189	98		
			15. 5	36		
			135. 2	36		
			222. 3	12	383, 761 60	
1942	Rouse's Point to Ogdensburg.....		119	9	14, 875 00	125 00
1944	Coblekill to Cherry Valley.....		92. 47	12	1, 123 50	50 00
1945	Albany to Binghamton.....		142	18	14, 342 00	101 00
1946	Schoharie to Middleburgh.....		5. 5	12	395 00	50 00
1947	Central Bridge to Schoharie.....		5	12	400 00	80 00
1948	Utica to Smith Valley Station.....		31. 4	6	1, 570 00	50 00
1949	Buffalo to Emporium.....		123. 51	6	7, 410 60	60 00
1950	Frederick to Dunkirk.....		3. 5	27	500 00	142 86
1951	Skaneateles Junction to Skaneateles.....		3. 5	12	560 00	50 00
1952	Brocton to Corv'is.....		45. 3	6	3, 000 00	53 00
1953	Chenestville to Warwick.....		11	12	550 00	50 00
1955	Canandaigua to Elmira.....		68. 5	12	8, 228 50	121 00
1956	Syracuse to Oswego.....		33. 5	18	3, 500 00	100 00
1957	Syracuse to Binghamton.....		80	12	7, 200 00	90 00
1958	Rouse's Point to Canada Line.....		2. 25	6	362 50	116 66
1959	Troy to North Adams, Mass.....		23. 2	24		
	Branch, North Hoosick Junction		185	12	6, 937 50	125 00
	to State Line.....		3. 5	6		
1960	Stapleton to Tottenville.....		21	12	1, 900 00	50 00
1961	Hudson to Chatham Village.....		17. 25	12	862 50	50 00
1962	East Galen'sville to Perry.....		6. 55	12	327 50	50 00
1964	Syracuse to Earlville.....		92. 47	12	2, 123 50	50 00

## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
<b>NEW YORK—Continued.</b>									
1265	Dunkirk to Titusville, Pa.	New York Central and Hudson River.	91.16	.....	6	4,558 00	.....	50 00	
1266	Ithaca to State Line.	Ithaca and Athens.	34.6	.....	6	1,730 00	.....	50 00	
1267	Syracuse to Lacona.	Rome, Watertown and Ogdensburg.	44.92	.....	12	2,470 60	.....	55 00	
1268	Rondont to Stamford.	New York, Kingston and Syracuse.	73.3	.....	12	3,665 00	.....	50 00	
1269	Ithaca to Cortland Village.	Utica, Ithaca and Elmira.	93	.....	12	1,495 00	.....	65 00	
1270	Port Jervis to Monticello.	Monticello and Port Jervis.	94	.....	6	1,200 00	.....	50 00	
1271	Poughkeepsie to State Line, Mass.	Poughkeepsie, Hartford and Boston.	43.15	.....	6	2,157 50	.....	50 00	
1272	Cannastota to Cazenovia.	Cazenovia, De Ruyter and Cannastota.	15	.....	18	750 00	.....	50 00	
1273	Fonda to Gloversville.	Fonda, Johnstown and Gloversville.	10	.....	12	1,390 00	.....	64 00	\$750 per annum included for side-service.
1274	Johnstown to Greenwiche.	Greenwiche and Johnstown.	14	.....	12	600 00	.....	42 86	
1275	Montgomery to Kingston.	Walkill Valley.	33.46	.....	6	1,003 80	.....	30 00	
1276	Athens, Pa. to Fair Haven, N. Y.	Southern Central.	122	.....	6	8,520 00	.....	60 00	\$1,200 per annum included for side-service.
1277	Newburgh to Millerton.	Dutchess and Columbia.	56.5	.....	6	3,050 00	.....	50 00	
1278	Branch, Clove Branch Junction to Sylvan Lake.	Cooperstown and Susquehanna Valley.	4.5	.....	6	1,000 00	.....	62 50	
1279	Chatham Village to Rutland, Vt.	Central Vermont.	111.3	.....	6	14,032 50	.....	125 00	
1280	Branch, North Bennington to State Line.	Delaware and Hudson Canal Company.	2	.....	6	1,150 00	.....	60 00	
1281	Plattsburgh to Au Sable Forks.	Utica and Black River.	23	.....	6	5,994 30	.....	65 00	
1282	Utica to Watertown.	Cayuga.	92.22	.....	12	2,359 10	.....	69 00	
1283	Cayuga to Ithaca.	Sodus Point and Southern.	38.05	.....	6	1,700 00	.....	50 00	
1284	Sodus Point to Carham Station.	Utica, Ithaca and Elmira.	34	.....	6	2,095 00	.....	50 00	
1285	Horseheads to Ithaca.	Rome, Watertown and Ogdensburg.	43.5	.....	6	3,422 00	.....	50 00	Pay estimated.
1286	Oswego to Charlotte.	.....	69.64	.....	6	.....	.....	50 00	Do.
1287	.....	.....	.....	.....	.....	.....	.....	.....	.....
1288	Cartage to Morris-town.	Utica and Black River.	20.5	.....	12	4,036 06	.....	75 00	
1289	Branch, Theresa Junction to Clayton.	.....	23.58	.....	12	.....	.....	57 00	
1290	Freeville to Solpico.	Utica, Ithaca and Elmira.	16.25	.....	12	1,441 00	.....	50 00	
1291	Buffalo to Jamestown.	Buffalo and Jamestown.	22.82	.....	6	4,478 67	.....	63 00	





## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			<i>Miles.</i>	<i>Miles.</i>		<i>Dollars.</i>	<i>Dollars.</i>	<i>Dollars.</i>	
			{ 25 27.5 7 }	.....	12 6 6 }	3,725 00	.....	{ 75 00 40 00 50 00 }	{ \$400 per annum included for mail-messenger service at Philadelphia. \$600 per annum included for mail-messenger service at Philadelphia.
2109	NEW JERSEY—Continued. (Philadelphia, Pa., to Hightstown, N. Y. Branch, Burlington to Mount Holly.	Pennsylvania.....	.....	.....	.....	.....	.....	.....	.....
2110	Philadelphia, Pa., to Bridgeton, N. J.	West Jersey.....	{ 18 20.4 }	.....	18 12 }	4,924 00	.....	110 00	\$100 per annum included for side-service.
2111	Glassborough to Millville.....	do.....	22	.....	12	2,200 00	.....	100 00	
2112	Millville to Cape May.....	do.....	41	.....	12	3,075 00	.....	75 00	
2113	Elmer to Salem.....	do.....	16.6	.....	12	1,000 00	.....	60 24	
2114	Mount Holly to Medford.....	Pennsylvania.....	6.5	.....	12	325 00	.....	50 00	
2115	Jamesburgh to Squan Village.....	Freehold, Jamesburgh and Agricultural, Pennsylvania.....	27	.....	12	1,892 13	.....	66 37½	
2116	Trenton to intersection with Delaware, Lackawanna and Western Railroad.	Pennsylvania.....	62.7	.....	20½	5,436 00	.....	80 00	
2117	Lambertville to Flemington.....	do.....	12.13	.....	12	606 50	.....	50 00	
2118	Greensburgh Station to New Brunswick.	do.....	29.13	.....	12	1,165 20	.....	40 00	
2119	New York to New Bridge.....	New Jersey and New York.....	16.5	.....	6	825 00	.....	50 00	
2120	New Bridge to Stony Point, N. Y.	do.....	27.18	.....	6	1,359 00	.....	50 00	Pay estimated.
	Waterloo to Franklin Furnace Branch.	Sussex.....	{ 12 12.76 }	.....	6 6 }	1,650 00	.....	50 00	\$100 per annum included for side-service on branch.
2121	Branch, La Fayette Junction to Branchville.	.....	6.24	.....	6	.....	.....	.....	
2122	New York to Denville.....	Delaware, Lackawanna and Western.	35.93	.....	12	4,024 16	.....	119 00	
2123	Dover to Chester.....	Morris and Essex.....	10	.....	6	500 00	.....	50 00	
2124	Newark to Mont Clair.....	Newark and Bloomfield.....	5.67	.....	12	283 50	.....	50 00	
2125	Rocky Hill to Monmouth Junction.	Pennsylvania.....	8	.....	6	400 00	.....	50 00	
	Sandy Hook to Pemberton Junction.	.....	{ 41.2 23.9 }	.....	12 6 }	.....	.....	67 00	
2126	Branch, Eatontown to Port Monmouth.	New Jersey Southern.....	9.8	.....	12	5,866 70	.....	50 00	
	Branch, Manchester to Barnegat Junction.	.....	20.3	.....	12	.....	.....	50 00	

## REPORT OF THE POSTMASTER-GENERAL.

[illegible]

## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and terminal.	Corporate title of company carrying the mail.	Distance. <i>Miles.</i>	Total distance in each State. <i>Miles.</i>	Number of trips per week.	Annual pay. <i>Dollars.</i>	Annual pay in each State. <i>Dollars.</i>	Annual cost per mile on each route.	Remarks.
	PENNSYLVANIA—Continued.								
2430	{ Bloomsburg to Corning, N. Y. Branch to Fall Brook. Branch to Morris Run. Branch to Arnot.	Tioga.	{ 39.88 6.85 3.8 3.79	..... ..... ..... .....	{ 12 12 6 6	3,713 00	.....	{ 75 00 50 00 50 00 50 00	
2421	Williamsport to Elmira, N. Y.	Northern Central	78	.....	12	13,650 00	.....	175 00	
2422	Sunbury to Erie	Pennsylvania	39.8	.....	18	36,010 20	.....	{ 114 00 50 00	
2423	Sunbury to Mount Carmel	Northern Central	26	.....	10	1,400 00	.....	40 00	
2424	Altoona to Corridon, N. Y.	Erie	25.5	.....	6	1,020 00	.....	67 00	
2425	Altoona to Corning, N. Y.	Pittsburgh, Titusville and Buffalo	95	.....	12	6,365 00	.....	58 83	
2426	Scranton to Lehigh Valley	Herr & Company	4.25	.....	6	250 00	.....	70 00	
2427	Scranton to Middletown	Pennsylvania	31.2	.....	15	2,184 00	.....	50 00	
2428	Harrisburg to Auburn	Philadelphia and Reading	58.3	.....	7½	2,915 00	.....	150 00	
2429	Newcastle to Homewood	Pittsburgh, Fort Wayne and Chicago.	15	.....	6	2,250 00	.....	77 00	
2430	Harrisburg to Martinsburgh, W. Va.	Cumberland Valley	94	.....	11½	7,238 00	.....	50 00	Pay estimated on 15.4 miles.
2431	{ Columbia to Sinking Spring. Branch, Junction to Quarryville	Reading and Columbia	{ 39.7 23.2	..... .....	{ 8½ 12	3,145 00	.....	50 00	
2432	York to Columbia	Pennsylvania	13.5	.....	6	675 00	.....	50 00	
2433	{ York to Frederick, Md. Branch, Hanover Junction to Hanover.	Hanover Branch	{ 36 13	..... .....	{ 7½ 6	3,450 00	.....	50 00	Pay estimated on 18.6 miles.
2434	Hanover to Gettysburgh	do	17.5	.....	12	1,050 00	.....	60 00	
2435	{ Huntingdon to Mount Dallas Station. Branch, Saxton to Dudley	Huntingdon and Broad Top	{ 44 6	..... .....	{ 6 6	3,000 00	.....	60 00	
2436	Tyrone to Curwinstville	Pennsylvania	47.1	.....	12	3,061 50	.....	65 00	Pay estimated on 6.5 miles.
2437	{ Altoona to Martinsburgh Branch, Duncansville to Newry Branch, Martinsburgh Junction to Henrietta.	do	{ 29.3 3 6.7	..... ..... .....	{ 10½ 6 6	1,600 00	.....	50 00	
2438	Cresson to Elvansburgh	do	11	.....	12	550 00	.....	50 00	
2439	{ Tyrone to Lock Haven Branch, Millsburgh to Bellefont	do	{ 55.1 2.7	..... .....	{ 12 12	3,605 75	.....	62 50 60 00	
2440	Blairville to Allegheny	do	63.7	.....	9½	4,140 50	.....	65 00	



## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance. Miles.	Total distance in each State.	Number of trips per week.	Annual pay. Dollars.	Annual pay in each State. Dollars.	Annual cost per mile on each route. Dollars.	Remarks.
PENNSYLVANIA—Continued.									
2477	Conshohocken to Flourtown .....	Philadelphia and Reading .....	7.25	.....	6	362 50	.....	30 00	\$145 per annum included for mail messenger service.
2479	Easton to Allentown .....	Lehigh Valley .....	16.58	.....	36	4,078 68	.....	246 00	
2480	Red Bank Furnace to Driftwood .....	Allegheny Valley .....	109.95	.....	6	5,497 50	.....	50 00	
2482	Chambersburg to Mont Alto .....	Mont Alto .....	14.75	.....	6	1,500 00	.....	40 00	
2483	Tunkhannock to Montrose .....	Montrose .....	25.24	.....	6	1,009 60	.....	40 00	
2484	Lawrenceville to Elkland .....	Fall Brook Coal Company .....	13.08	.....	12	654 00	.....	50 00	
2485	Mechanicsburgh to Dillsburgh .....	Cumberland Valley .....	8.85	.....	6	354 00	.....	40 00	
2486	Pittsburgh to Monacaola City .....	Pittsburgh, Virginia and Charleston.	31.84	.....	9	2,133 38	.....	67 00	
2487	Valley Junction to Ebbwale, Md .....	Bachman Valley .....	13.3	.....	6	399 00	.....	30 00	
2488	Perryroy to Delaware City, Del .....	Pennsylvania .....	35.36	.....	6	1,543 20	.....	40 00	
2489	Hollidaysburgh to Royer .....	do .....	21.25	.....	6	956 25	.....	45 00	
2490	Mount Union to Broad Top .....	East Broad Top Railroad and Coal Company.	32.23	.....	6	1,269 20	.....	40 00	
2491	Pollock to Karns City .....	Parker and Karns City .....	10	.....	12	600 00	.....	60 00	
2492	Antietam to Lloydsville .....	Bell's Gap .....	8.82	.....	6	441 00	.....	50 00	
2493	Phillipsburgh to Morrisdale Mines .....	Pennsylvania .....	3.60	.....	6	144 59	.....	50 00	
2494	Reading to Slatington .....	Philadelphia and Reading .....	43.32	.....	6	1,949 40	.....	45 00	
2495	Berlin to Garrett .....	Buffalo Valley .....	8.62	.....	12	431 00	.....	50 00	
2495a	Larabee to Clermont .....	McKean and Buffalo .....	23.3	.....	6	1,048 50	.....	45 00	
2496	York to Delta .....	Peach Bottom .....	35.56	.....	6	1,778 00	.....	50 00	
2496a	Harris to Williams' Mill .....	Harrisburgh and Potomac .....	13.9	.....	6	695 00	.....	50 00	
2497	Lawsanham to Sligo .....	Allegheny Valley .....	10.47	.....	6	418 50	.....	40 00	
2497a	Norristown to Lansdale .....	Stony Creek .....	10.9	.....	6	545 00	.....	50 00	
2498	Oxford to Peter's Creek .....	Peach Bottom .....	20.500	.....	6	820 24	.....	40 00	
2499	Pittsburgh to Castle Shannon .....	Pittsburgh and Castle Shannon .....	7	.....	6	350 00	.....	50 00	
2500	Newcastle to Stoneborough .....	Newcastle and Franklin .....	36.5	.....	6	1,825 00	.....	50 00	
				4,432.946			466,514.22		
DELAWARE.									
3401	Wilmington to Delmar .....	Philadelphia, Wilmington and Baltimore.	84	.....	12	14,815 50	.....	157 00	{
3402	Delmar to Crisfield .....	Eastern Shore Railroad Company of Maryland.	38	.....	6	2,470 00	.....	125 00	
								65 00	

3403	Chayton to Oxford, Md	53.75	6	2,921 00	52 50	Pay estimated on 9.75 miles.
3404	Harrington to Lower	40	6	2,000 00	50 00	
3405	Wilmington and Breakwater	18.50	6	781 80	40 00	
3406	Georgetown to Solbyville	19.3	6	965 00	50 00	Pay estimated.
			307.6		23,853 56	
	MARYLAND.					
3501	{ Baltimore to Philadelphia, Pa., } Branch, Perryville to Port De- } pot.	96	284	51,848 00	538 00	
3502	Baltimore to Sunbury, Pa.	140.7	18	28,702 80	50 00	
3504	Baltimore to Wheeling, W. Va.	40	46	122,586 00	904 00	
3505	Araby to Frederick	353	18			{ 204 miles, at \$322.
3506	Weyerton to Hagerstown	3	12	1,385 85	100 00	{ 99 miles, at \$282.
3507	Baltimore to Williamsport	24.25	12	6,657 30	75 00	
3508	Annapolis to Annapolis Junction	85.5	12	1,537 50	75 00	
3509	Cambridge to Stafford, Del	6.12	6	1,675 00	50 00	
3510	Salisbury to Berlin	33.5	6	1,150 00	50 00	
3511	Towson, Del. to Centreville, Md	23	6	1,900 00	50 00	
3512	Cambridge to Piedmont, W. Va.	36	6	1,710 00	50 00	
3513	Chayton, Del. to Chestertown, Md	34	6	2,310 00	75 00	
3514	Baltimore to Washington, D. C.	30.8	6	18,360 60	431 00	Pay estimated on 11.25 miles.
3515	Bowie to Pope's Creek	42.6	6	2,434 00	50 00	
3516	Newtown Junction to Newtown	48.68	6	450 00	50 00	
3517	Solbyville, Del., to Greenback	9	6	1,762 00	50 00	Pay estimated on 21.94 miles.
3518	Saint Denis to Point of Rocks	35.24	6	6,000 00	100 00	
3519	Lake Roland to Western Mary-	60	6	425 00	50 00	Pay estimated.
3520	land Railroad Junction.	8.5	6	350 00	50 00	
	Emmitsburgh to Rooky Ridge	7	6		50 00	
		1,141.39			251,333 45	
	WEST VIRGINIA.					
12001	Harper's Ferry to Harrisonburgh,	100.47	6	8,339 01	83 00	
12002	Va.					
12003	Grafton to Parkersburgh	104.58	14	31,886 90	305 00	
12004	Laurel Junction to Volcano	10	18	400 00	40 00	
12005	Pennsborough to Ritchie C. H.	9	6	450 00	50 00	
		294.05			41,085 91	
	VIRGINIA.					
11001	Washington, D. C., to Richmond,	131	13	34,715 00	985 00	
	Va.					

## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			<i>Miles.</i>	<i>Miles.</i>		<i>Dollars.</i>	<i>Dollars.</i>	<i>Dollars.</i>	
	VIRGINIA—Continued.								
11002	{ Alexandria to Lynchburg..... } Branch, Warrenton Junction to Warrenton.	Washington City, Virginia Mid-land and Great Southern.	{ 170.83 9 }	.....	13 6 }	43, 155 00	.....	{ 250 00 50 00 }	
11003	Mauassas to Strasburg.....	do	62.55	.....	6	3, 190 05	.....	51 00	
11004	Alexandria to Round Hill.....	Washington and Ohio.....	52.74	.....	6	2, 795 52	.....	53 00	
11005	Richmond to Huntington, W. Va.....	Chesapeake and Ohio.....	{ 272.96 148.6 }	.....	12 12 }	34, 925 40	.....	90 00	
11006	Richmond to Greensborough, N. C.....	Richmond and Danville.....	185.58	.....	16	32, 228 60	.....	65 00	
11007	Richmond to West Point.....	Richmond, York River and Chesapeake.	39.84	.....	6	1, 992 00	.....	170 00	
11008	Richmond to Petersburg.....	Richmond and Petersburg.....	24.07	.....	14	5, 734 34	.....	50 00	
11009	Petersburgh to Weldon, N. C.....	Petersburgh.....	65.51	.....	14	14, 543 92	.....	222 00	
11010	Petersburgh to City Point.....	Atlantic, Mississippi and Ohio.....	10.75	.....	6	537 50	.....	50 00	
11011	Petersburgh to Norfolk.....	do	82.4	.....	6	4, 944 00	.....	60 00	
11012	Petersburgh to Lynchburg.....	do	127.75	.....	6	8, 043 75	.....	65 00	
11013	Lynchburg to Bristol, Tenn.....	do	205	.....	14	49, 200 00	.....	240 00	
11014	Glade Spring to Saltville.....	do	10	.....	6	25 00	.....	28 50	
11015	Portsmouth to Weldon, N. C.....	Seaboard and Roanoke.....	79.26	.....	6	4, 676 34	.....	59 60	
11016	Lynchburg to Danville.....	Washington City, Virginia Mid-land and Great Southern.	66.34	.....	6	3, 317 00	.....	50 00	
11017	Chester to Wintepook.....	Richmond and Petersburg.....	18.5	.....	13	1, 750 00	.....	250 00	
11018	Washington, D.C., to Alexandria, Va.....	Alexandria and Washington.....	7	1, 769 67	.....	.....	245, 702 32	.....	
	NORTH CAROLINA.								
13001	Raleigh to Weldon.....	Raleigh and Gaston.....	97	.....	6	7, 375 00	.....	75 00	
13002	{ Weldon to Wilmington..... } Branch, Rocky Mount to Tarborough.	Wilmington and Weldon.....	{ 163 17 }	.....	13 7 }	28, 986 00	.....	{ 172 00 50 00 }	
13003	Wilmington to Charlotte.....	Carolina Central.....	189.66	.....	6	10, 431 30	.....	55 00	
13004	Goldaborough to Charlotte.....	Richmond and Danville.....	130.35	.....	14	92, 028 95	.....	75 00	
13005	Goldaborough to Morehead City.....	Atlantic and North Carolina.....	95	.....	12	5, 225 00	.....	164 00	
13006	Salisbury to Henry's.....	Western North Carolina.....	117.31	.....	6	5, 681 67	.....	55 00	
								57 00	Pay estimated on 3 miles.
									\$150 per annum included for mail-messenger service.



13007	Charlotte to Augusta, Ga.	107	13	34,625 00	125 00
13008	Charlotte to Shelby	56 75	6	2,837 50	50 00
13009	Charlotte to Staunton	40 34	6	2,322 10	45 00
13010	Raleigh to Cameron	45 78	6	3,076 34	50 00
13011	Fayetteville to Sanford	13	6	2,296 50	50 00
13012	Branch, Sanford to Egypt Depot	38 53	6	1,465 50	50 00
	Greensborough to Salem	6	6	119,985 16	
		920 31			
		1,332 07			
	<b>SOUTH CAROLINA.</b>				
	Columbia to Greenville C. H.	144 01	6	9,443 58	58 00
14001	Branch, Cokesbury to Abbeville	11 81	6		50 00
	C. H.	10 01	6		50 00
	Branch, Belton to Anderson C. H.	42 08	6		100 00
14002	Columbia to Florence	106 7	13	25,211 50	155 00
	Branch, Florence to Wilmington		13		70 00
	ton, N. C.	129 28	13		50 00
14003	Kingsville to Augusta, Ga.	37 95	6	18,176 10	70 00
	Branch, Kingsville to Camden	36 7	13		80 00
	Branch, Kingsville to Columbia	63 5	13		111 00
	Brauch, Branchville to Charleston		13		116 00
14004	Charleston to Savannah, Ga.	104	13	11,544 00	33 00
14005	Charleston to Florence	103	6	11,948 00	50 00
14006	Florence to Cheraw	40 88	6	2,166 64	50 00
14007	Chester C. H. to Yorkville	34 25	6	1,212 50	50 00
14008	Alston to Spartanburgh C. H.	64 75	6	3,437 50	40 00
14009	Anderson C. H. to Walhalla	34	6	1,360 00	50 00
14010	Port Royal to Augusta, Ga.	112 28	6	5,614 00	90,113 94
		1,106 2			
	<b>GEORGIA.</b>				
15001	Atlanta to Charlotte, N. C.	266 5	7	26,650 00	100 00
15002	Atlanta to Chattanooga, Tenn.	138 75	14	28,443 75	205 00
15003	Atlanta to West Point	86 68	7	13,522 08	156 00
15004	Augusta to Atlanta	171 62	13	25,228 14	147 00
15005	Millen to Augusta	53 125	14	4,196 87	79 00
15006	Washington to Double Wells	18 85	6	943 50	50 00
15007	Union Point to Athens	39 92	6	2,794 88	64 00
15008	Kingsdon to Rome	90 35	7	1,017 50	50 00
15009	Savannah to Live Oak	190 47	13	27,832 94	120 00
	Branch, Du Pont to Bainbridge	106 48	7	58 00	58 00
15010	Savannah to Macon	192 125	14	15,370 00	80 00
15011	Macon to Columbus	100 94	13	7,570 50	75 00

\$240 per annum included for mail-messenger service.

B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			<i>Miles.</i>	<i>Miles.</i>		<i>Dollars.</i>	<i>Dollars.</i>	<i>Dollars.</i>	
<b>GEORGIA—Continued.</b>									
15012	Macon to Atlanta.....	Central Railroad and Banking Company.	103.52	.....	13	11,387 50	.....	110 00	
15013	Macon to Brunswick Branch, Cochran to Hawkinsville.	Macon and Brunswick	188	.....	7	12,620 00	.....	65 00	
15014	Gordon to Milledgeville.....		10	.....	6		.....	40 00	
15015	Eatonton to Milledgeville Fort Valley to Eataula, Ala. Branch, Smithville to Albany. Branch, Cuthbert to Fort Gaines.	Central Railroad and Banking Company.	18.25	.....	6	912 50	.....	50 00	
15016	Fort Valley to Perry. Branch, Albany to Arlington.	do	92.125	.....	6	1,106 25	.....	50 00	
15017	Thomasville to Albany.....	Southwestern.....	115.34	.....	10	11,944 60	.....	70 00	
15018	Barnesville to Thomaston.	do	23.78	.....	10		.....	50 00	
15020	Cartersville to Rock Mart.	Atlantic and Gulf	22	.....	6	666 00	.....	50 00	
15021	Camak to Macon.....	Central Railroad and Banking Company.	60.79	.....	6	3,768 98	.....	62 00	
15022	Griffin to Carrollton.....	Cherokee	17.25	.....	6	690 00	.....	40 00	
15023	Brunswick to Albany.....	Macon and Augusta	80.66	.....	6	660 00	.....	30 00	
15024	Columbus to Hamilton.....	Savannah, Griffin and North Alabama.	59.96	.....	6	2,693 70	.....	45 00	
		Brunswick and Albany	173.21	.....	3	5,199 30	.....	30 00	
		North and South.	23.51	.....	6	1,057 95	.....	45 00	
			2,365.695	.....		210,630 58	.....		
<b>FLORIDA.</b>									
16001	Fernandina to Cedar Keys.....	Atlantic, Gulf, and West India Transit Company.	154.8	.....	6	7,740 00	.....	50 00	
16002	Jacksonville to Chattahoochee River. Branch, Tallahassee to Saint Marks.	Jacksonville, Pensacola and Mobile.	213.52	.....	11½	17,519 40	.....	80 00	
16003	Pensacola to Whiting Junction, Ala.		21.89	.....	3		.....	20 00	
		Pensacola and Louisville.	44.05	.....	7	2,900 00	.....	50 00	

Pay estimated on 35.5 miles.

19004	Trent to Saint Augustine	13.69	784.50	50.00
19003	Pensacola to Millview	10.027	318.75	30.00
19002		460.575		98,563.65
ALABAMA.				
17001	Montgomery to West Point, Ga.	68.5	13,540.50	153.00
17002	Montgomery to Selma	50	2,700.00	54.00
17003	Montgomery to Enfauila	81.84	50	50.00
17004	Montgomery to Decatur	63.8	4,062.00	117.50
	{	119.05	16,425.85	75.00
	{	271.5		160.00
17005	Memphis, Tenn., to Stevenson, Ala.	14.5	44,900.00	30.00
17006	Branch, Moscow, Tenn., to Sonerville.	6.5		50.00
17007	Branch, Tusculumbia to Florence.	37.25	1,862.50	50.00
17008	Marion Junction to Greensborough.			63.00
17009	Opelika to Columbus, Ga.	28	1,764.00	50.00
17010	Columbus, Ga. to Troy, Ala.	90	4,500.00	50.00
17011	Selma to York Station	81.7	4,375.80	50.00
	{	237.5	17,812.50	75.00
	{	32	990.00	45.00
17012	Gainesville to Gainesville Junction, Miss.	179	26,850.00	150.00
17013	Mobile to Montgomery	140	18,500.00	130.00
17014	Mobile to New Orleans, La.	140	800.00	40.00
17015	Opelika to Buffalo	22.5	15,635.00	53.00
	{	295		50.00
	{	47.98	2,856.80	40.00
	{	12.37		40.00
17016	Savannah and Memphis.	6	1,737.60	30.00
17017	Selma and Gulf.	4	2,001.00	50.00
17018	Mobile and Alabama Grand Trunk	6	300.00	50.00
17019	Tuskegee	6	300.00	50.00
17020	Cheshaw to Tuskegee	6	1,125.00	50.00
17021	Atalla to Gadsden	22.5	1,025.00	50.00
17022	Evadale to Clayton	20.5		183,354.35
	{	2,045.58		
	{			
MISSISSIPPI.				
18001	Canton to Cairo, Ill.	342.98	61,736.40	190.00
18002	Memphis, Tenn., to Grenada, Miss	101.7	6,610.50	65.00
18003	Vicksburgh to Meridian.	45.5	10,166.80	100.00
	{	95.2		50.00

**\$210 per annum included for mail-messenger service.**

## REPORT OF THE POSTMASTER-GENERAL.

B.—Railroad-service as in operation on the 30th of June, 1878—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			<i>Miles.</i>	<i>Miles.</i>		<i>Dollars.</i>	<i>Dollars.</i>	<i>Dollars.</i>	
			$\left\{ \begin{array}{l} 472.7 \\ 14 \end{array} \right\}$		$\left\{ \begin{array}{l} 7 \\ 14 \end{array} \right\}$	39,461 40		$\left\{ \begin{array}{l} 88 00 \\ 50 00 \end{array} \right\}$	
18004	Missouri—Continued.	Mobile, Ala., to Columbus, Ky. . . . .							
		Branch, Artesia to Columbus, } Miss.							
18006		Grand Gulf to Port Gibson . . . . .	8		6	600 00		75 00	
18007		Muldon to Aberdeen . . . . .	9		14	360 00		40 00	
18008		Middleton Station, Tenn., to Ripley, Miss. . . . .	24.3		6	973 00		40 00	
18009		Durant to Koechnuko . . . . .	21.57		6	893 80		40 00	
		Chicago, operating Mississippi Central Railroad.		1,134.95			190,769 90		
	LOUISIANA.								
30001		New Orleans to Canton, Miss. . . . .	206		13	37,286 00		181 00	
30002		New Orleans to Donaldsonville. . . . .	63.66		6	3,183 00		50 00	
30003		New Orleans to Brashear Railroad. . . . .	23		7	9,530 00		110 00	\$400 per annum included for side-supply.
30004		Terre Bonne to Houma . . . . .	15.28		7	764 00		50 00	
30005		Baton Rouge to Livonia . . . . .	28		3	560 00		80 00	
30006		Clinton to Port Hudson . . . . .	21		3	630 00		30 00	
30007		Saint Francisville to Woodville, Miss. . . . .	27.57		3	964 95		35 00	
30008		Vicksburg, Shreveport and Texas	75.5	520.01	7	4,350 50	57,266 45	51 00	\$500 per annum included for mail-messenger service and ferrriage.
	TEXAS.								
31001		Houston to Galveston . . . . .	50		19	7,250 00		145 00	
31002		Harrisburgh to Kingsbury. . . . .	163.6		12	14,163 40		84 00	Pay estimated on 13.4 miles.
31003		Houston to Donlon City . . . . .	337.55		6	42,193 75		125 00	
31004		Hempstead to Austin . . . . .	118.7		6	10,683 00		90 00	

31005	Fromont to Waco	44.56	6	3,342 00	75 00
31006	{ Longview to Houston	{ 220	{ 6	{ }	{ 125 00
	{ Branch, Minicola to Zavala	{ 44, 125	{ 6	{ }	{ 50 00
31007	Branch, Phelps to Huntsville	8.5	6	34, 491 25	50 00
31008	Patetino to Rockdale	121	6	6, 050 00	50 00
	do do	50	3	1, 250 00	25 00
31009	Houston to Columbia	40	12	17, 028 00	90 00
	Texas and Pacific	149.2	6	11, 100 00	150 00
31010	Shreveport, La., to Dallas, Tex	74	6	9, 907 00	51 00
31011	Marshall to Texarkana, Ark	57	6	150, 457 40	
	Sherman to Brookston	1, 409.235			
ARKANSAS.					
29001	Memphis, Tenn., to Argenta, Ark	124	7	14, 070 00	105 00
29002	Hickox to Clarendon	48.9	3	2, 169 00	45 00
29003	Chicot to Pine Bluff	72.78	3	2, 183 40	30 00
	Texas, Mississippi River and Northwestern				
29004	Chicot to Monticello	44.98	3	1, 298 46	30 00
29005	Argenta to Osark	195.64	6	10, 679 40	85 00
29006	Malvern to Hot Springs	23.11	6	1, 253 50	50 00
		456.01		31, 685 70	
MISSOURI.					
28001	Saint Louis to Atchison, Kans	329.75	131	75, 183 00	238 00
28002	{ Saint Louis to Columbus, Ky	{ 197	{ 13	{ 26, 568 00	{ 144 00
	{ Branch, Mineral Point to Potosi	{ 4	{ 6	{ 37, 633 75	{ 115 00
28003	Pacific to Vinita, Indian Ter	327.25	6	42, 866 50	155 00
28004	Saint Louis to Kansas City	376.56	142		
	thence				
28005	Quincy, Ill., to Saint Joseph, Mo	171	12	48, 777 50	240 00
	Branch, Palmyra to Hannibal	32.5	7	215 00	215 00
28006	Kansas City to Union Pacific	13	13	50 00	50 00
	Transfer, Iowa	203.5	12	35, 409 00	174 00
28007	Moberly to Ottumwa, Iowa	131	6	10, 480 00	80 00
28008	Tipiton to Booneville	25	6	1, 275 00	51 00
28009	Centralia to Columbia	23	6	1, 110 00	50 00
28010	Kansas City to Cameron	54	6	13, 036 00	239 00
28011	Sedalia to Denison City, Tex	447	7	84, 930 00	190 00
28012	Saint Joseph to Lexington	76.75	7	3, 914 25	51 00
28013	Brunswick to Pattonaburgh	80.05	6	4, 092 30	50 00
	Brunswick and Chillicothe and Saint Louis, Council Bluffs and Omaha				
28014	Hannibal to Sedalia	142.88	7	25, 718 40	180 00

Pay estimated on 5.64 miles.  
Pay estimated.

\$730 per annum included for  
freight.

B.—Railroad service as in operation on the 30th of June, 1876—Continued.

Number of route	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
<b>MISSOURI—Continued.</b>									
28015	Alexandria to Centerville .....	Missouri, Iowa and Nebraska .....	85.63	.....	6	4,281 50	.....	50 00	Pay estimated on 26.08 miles.
28016	Pleasant Hill to Carbondale .....	Saint Louis, Lawrence and Western .....	94	.....	6	5,433 00	.....	58 00	
28017	Sedalia to Lexington .....	Atlantic and Pacific .....	56.25	.....	6	2,812 50	.....	50 00	
28018	Keokuk, Iowa, to Louisiana, Mo. ....	Saint Louis, Keokuk and Northwestern .....	86.8	.....	6	6,510 00	.....	75 00	
28019	Quincy, Ill., to Kirksville, Mo. ....	Quincy, Missouri and Pacific .....	71.28	.....	12	4,134 24	.....	58 00	
28020	Pierce City to Brownsville, Kans. ....	Joseph Seligman and Josiah Macy, Jr., purchasers of Memphis, Carthage and Northwestern Railroad .....	48.31	.....	6	2,415 50	.....	50 00	
28021	Mexico to Cedar City .....	Chicago and Alton .....	50.62	.....	6	2,531 00	.....	50 00	Pay estimated.
28022	Road House, Ill., to Mexico, Mo. ....	do .....	90	.....	12	12,780 00	.....	142 00	
28023	Cuba to Salem .....	Saint Louis, Salem and Little Rock .....	40.88	.....	6	2,044 00	.....	50 00	
28024	Holden to Paola, Kans. ....	Missouri, Kansas and Texas .....	55	.....	6	2,750 00	.....	50 00	
28025	Salisbury to Glasgow .....	Saint Louis, Kansas City and Northern .....	15.66	.....	12	763 00	.....	50 00	
28026	Bismarck to Texarkana, Ark. ....	Saint Louis, Iron Mountain and Southern .....	414.25	.....	7	64,208 75	.....	155 00	
28027	Cairo, Ill., to Poplar Bluff, Mo. ....	do .....	73.73	.....	6	3,685 50	.....	50 00	
28028	Saint Joseph to Hopkins .....	Kansas City, Saint Joseph and Council Bluffs .....	61.5	.....	6	4,305 00	.....	70 00	
28029	Hannibal to Bowling Green .....	Saint Louis, Hannibal and Keokuk .....	32.52	.....	6	1,626 00	.....	50 00	
28030	Saint Joseph to Atchison, Kans. ....	Hannibal and Saint Joseph .....	92.08	.....	6	1,104 00	.....	50 00	
28031	Saint Louis to Normandy .....	West End Narrow Gauge .....	10.53	.....	6	525 50	.....	50 00	Do.
28032	Atchison, Kans., to Edgerton Junction, Mo. ....	Chicago, Rock Island and Pacific .....	30	.....	6	1,500 00	.....	50 00	Do.
				3,874.28			536,944.69		
19002	Bristol to Chattanooga .....	{ East Tennessee, Virginia and Georgia.	{ 242.7	.....	14 }	62,068 80	.....	244 00	{ 944 00
19003	Branch, Cleveland to Dalton, Ga. ....	W. P. Elliott, owner of Rogersville and Jefferson, Railroad.	98.5	.....	7 }	790 00	.....	100 00	
	Rogersville to Bull's Gap .....		15	.....	6		.....	52 66	
<b>TENNESSEE.</b>									



## REPORT OF THE POSTMASTER-GENERAL.

B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and terminal.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
	OHIO.		Miles.	Miles.		Dollars.	Dollars.	Dollars.	
9001	Bellaire to Columbus.....	Central Ohio.....	137.875	.....	12	36,812.62	.....	287.00	
9002	Pittsburgh, Pa., to Chicago, Ill. . .	Pittsburgh, Fort Wayne and Chicago.....	35	.....	12	98,475.50	.....	219.00	
9003	Rochester, Pa., to Bellaire, Ohio.....	Cleveland and Pittsburgh.....	434.5	.....	12	6,875.00	.....	269.00	
9005	Hudson to Columbus.....	Cleveland, Mount Vernon and Delaware.....	68.75	.....	18	17,067.98	.....	100.00	
			145.88	.....	6		.....	117.00	
9006	Cleveland to Sharpsville.....	Atlantic and Great Western.....	49.75	.....	6	6,707.75	.....	100.00	
			31.61	.....	6		.....	50.00	
			3.045	.....	6		.....	50.00	Pay estimated on 3,045 miles.
9007	Cleveland to Wollsville.....	Cleveland and Pittsburgh.....	56.5	.....	18	15,568.72	.....	153.00	
9008	Elvira to Millbury.....	Lake Shore and Michigan Southern.....	45.86	.....	12	58,609.90	.....	705.00	
9009	Bayard to New Philadelphia.....	Cleveland and Pittsburgh.....	74.98	.....	12	1,625.00	.....	50.00	\$3,749 per annum included, for additional line of rail.
9010	Onedia Mills to Carrollton.....	Carrollton and Onedia.....	32.5	.....	6	8,500.00	.....	41.66	way post-office cars.
9011	Sandusky to Newark.....	Baltimore and Ohio, Leases of Sandusky, Mansfield and Newark Railroad.....	116	.....	6	17,632.00	.....	153.00	
9012	Xenia to Dayton.....	Pittsburgh, Cincinnati and Saint Louis.....	17	.....	12	1,598.00	.....	94.00	
9013	Springfield to Sandusky.....	Cincinnati, Sandusky and Cleveland.....	131.35	.....	13	11,463.12	.....	87.50	
9015	Columbus to Delaware.....	Cleveland, Columbus, Cincinnati and Indianapolis.....	94.75	.....	24	2,970.00	.....	120.00	
9016	Columbus to Xenia.....	Columbus and Xenia.....	55	.....	13	11,550.00	.....	210.00	
9017	Columbus to Indianapolis, Ind.....	Columbus, Chicago and Indiana Central.....	188	.....	12	31,308.00	.....	166.00	
9018	Gallon to Indianapolis, Ind.....	Cleveland, Columbus, Cincinnati and Indianapolis.....	304	.....	12	37,740.00	.....	185.00	
9019	Blanchester to Hillsborough.....	Marietta and Cincinnati.....	21	.....	6	1,701.00	.....	81.00	
9020	Fortsmouth to Reed's Mills.....	do.....	56	.....	6	8,948.00	.....	186.00	
			198	.....	12		.....	255.00	
9022	Toledo to Quincy, Ill. . .	Toledo, Wabash and Western.....	378	.....	12	139,472.00	.....	273.00	
	Branch, Bluff City to Naples.....		4	.....	6		.....	90.00	
	Branch, Clayton to Keokuk.....		44	.....	6		.....	62.00	
9024	Fremont to Saint Mary's.....	Lake Erie and Lodiaville.....	89.35	.....	6	4,467.50	.....	50.00	
9025	Carey to Findlay.....	Cincinnati, Sandusky and Cleveland.....	16	.....	12	800.00	.....	50.00	



9000	Dayton to Union City.....	48.17	6	9,800 90	60 00
9007	Dayton to Toledo.....	71.43	18	91,444 00	150 00
9008	Hamilton to Indianapolis, Ind.....	71.53	19	4,974 50	50 00
9009	Hamilton to Richmond, Ind.....	96.49	6	5,321 80	118 00
9030	Cincinnati to Dayton.....	45.1	6	10,063 37	187 50
9031	Cincinnati to Springfield.....	96.51	43	14,801 60	210 00
9032	Cincinnati to Parkersburg, W. Va.....	33.99	13	72,790 95	373 00
9033	Morrow to Dresden.....	63.96	6	11,905 00	75 00
9034	Dayton to Richmond, Ind.....	19	6	9,730 00	65 00
9035	North Bend to Hagerstown, Ind.....	193.15	7	4,536 25	68 50
9036	{ Columbus to Pittsburgh, Pa.....	149.4	6	44,790 00	230 00
9037	{ Branch, Means to Cadiz.....	43.86	14	9,364 72	50 00
9038	Springfield to Columbus.....	389.55	6	35,059 50	53 00
9039	Salamanca, N. Y., to Dayton, Ohio.....	92.8	12	7,923 30	87 50
9040	Youngstown to Cross Cut.....	77.4	13	1,697 00	40 00
9041	{ Columbus to Athens.....	13.02	19	3,303 37	50 00
9042	{ Branch, Logan to New Straiteville.....	33.94	6	548 00	75 00
9043	Niles to New Lisbon.....	44.045	12	4,998 00	50 00
9044	Newark to Shawnee.....	13.7	6	5,132 50	50 00
9045	Clinton to Massillon.....	99.96	6	60,124 25	237 00
9046	Marletta to Canal Dover.....	102.45	6	5,286 00	60 00
9047	Lorain to Uhrickville.....	245.25	12	3,105 00	50 00
9048	Cleveland to Cincinnati.....	88.1	6	83,500 00	575 00
9049	Mansfield to Toledo.....	62.1	6	2,404 80	40 00
9050	Harbor to Youngstown.....	133.6	12	63,809 53	233 00
9051	Toledo to Elkhart, Ind.....	60.12	6		
9052	Painesville to Youngstown.....	271.53	6		
9053	Chicago, Ohio, to Chicago, Ill.....		6		

\$2,000 per annum included for additional daily line of railway post-office cars.

\$6,680 per annum included for additional daily line of railway post-office cars. Pay estimated on 9.38 miles.

B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route	State and terminal.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	Pay estimated. Do. Do. Do.
<b>OHIO—Continued.</b>									
9032	Dyon's to Cumberland	Eastern Ohio	7.8	.....	6	380 00	.....	50 00	
9033	Marietta to Parkersburgh, W. Va.	Marietta and Cincinnati	13.87	.....	6	783 50	.....	50 00	
9034	Athens to Scott's Landing	do	37	.....	6	1,450 00	.....	50 00	
9035	Columbus to Circleville	Scioto Valley	31.2	.....	6	1,560 00	.....	50 00	
				5,507.253			979,696 63		
<b>INDIANA.</b>									
92001	Indianapolis to Vincennes	Indianapolis and Vincennes	116.32	.....	6	5,816 00	.....	50 00	
92002	Indianapolis to Terre Haute	Terre Haute and Indianapolis	73	.....	21	13,184 00	.....	208 00	
92003	Indianapolis to Cincinnati, Ohio	Indianapolis, Cincinnati and La Fayette	113.5	.....	18	30,418 00	.....	268 00	
92004	Indianapolis to Peru	Indianapolis, Peru and Chicago	54	.....	18	8,400 00	.....	100 00	
92005	Indianapolis to La Fayette	Indianapolis, Cincinnati and La Fayette	54	.....	18	17,183 75	.....	262 00	
92006	Columbus to Madison	Jeffersonville, Madison and Indianapolis	65.625	.....	6	9,300 00	.....	50 00	
92007	New Albany to Indianapolis	do	114	.....	18	15,376 00	.....	134 00	
92008	New Albany to Michigan City	Louisville, New Albany and Chicago	61	.....	12	14,400 00	.....	50 00	
92009	Richmond to Chicago, Ill.	Pittsburgh, Cincinnati and Saint Louis	237	.....	12	16,912 50	.....	75 00	
			225.5	.....					
92010	Cincinnati, Ohio, to East Saint Louis, Ill.	Ohio and Mississippi	72.4	.....	19	88,424 00	.....	279 00	
92011	Cambridge City to Columbus	Jeffersonville, Madison and Indianapolis	98.6	.....	6	9,720 00	.....	254 00	
92012	Evansville to Terre Haute	Evansville and Crawfordsville	110	.....	12	11,000 00	.....	40 00	
92013	Terre Haute to Rockville	Logansport, Crawfordsville and Southwestern	93	.....	6	1,150 00	.....	100 00	
92014	State Line to Logansport	Pittsburgh, Cincinnati and Saint Louis	61	.....	6	4,575 00	.....	50 00	
92015	Peru to La Porte	Chicago, Cincinnati and Louisville	73	.....	6	4,015 00	.....	75 00	
92016	Fairland to Martinsville	Cincinnati and Martinsville	38.5	.....	6	1,925 00	.....	35 00	
92017	Bradford, Ohio, to Logansport, Ind	Pittsburgh, Cincinnati and Saint Louis	114.6	.....	6	5,730 00	.....	50 00	

\$600 per annum included for side-service.

Year	Location	Pay estimated on 23.08 miles.
1901	Indianapolis to Pooria, Ill.	135 00
1902	Jeffersonville to North Vernon	175 00
1903	Fort Wayne to Connersville	53 00
1904	Richmond to Fort Wayne	50 00
1905	Anderson to Goshen	50 00
1906	Princeton to Albion, Ill.	35 00
1907	Terre Haute to Danville, Ill.	54 00
1908	Indianapolis to Terre Haute	196 00
1909	La Porte to Michigan City	50 00
1910	Butler to Logansport	53 00
1911	Rockville to Logansport	50 00
1912	La Fayette to Kankakee, Ill.	262 00
1913	Terre Haute to Mertz	35 00
1914	Attica to Veedersburgh	40 00
1915	Evansville to Boonville	50 00
1916	Frankfort to Kokomo	40 00
1917	Rockport to Huntingburgh	50 00
1918	Indianapolis to Terre Haute	353, 245 95
1919	Chicago to Milwaukee, Wis.	232 00
1920	Chicago to Freeport	203 00
1921	Chicago to Union Pacific Trans-fer	263 00
1922	Elgin to Geneva	50 00
1923	Sterling to East Saint Louis	70 00
1924	Chicago to Burlington, Iowa	328 00
1925	Branch, Aurora to Galena Junction	328 00
1926	Branch, Galva to Keithsburg	58 00
1927	Rushville to Yates City	57 00
1928	Branch, Elmwood to Buda	58 00
1929	Pooria to Galesburg	175 00
1930	Galesburg to Quincy	301 00
1931	Burlington, Iowa, to Quincy, Ill	62 00
1932	Strator to Aurora	60 00
1933	Branch, Aurora to Batavia	50 00
1934	Mendota to Clinton	50 00
1935	Rock Falls to Cornaton	319 00
1936	Chicago to Davenport, Iowa	344 00

## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
ILLINOIS—Continued.									
23016	Bureau Junction to Peoria.....	Chicago, Rock Island and Pacific.	47	.....	12	4,700 00	.....	100 00	
23017	Chicago to East Saint Louis.....	Chicago and Alton.....	283	.....	184	60,562 00	.....	914 00	
23018	Bloomington to Godfrey.....	do.....	111.4	.....	94	19,069 80	.....	130 00	
23019	{ Washington to Dwight.....	do.....	40.6	.....	94	.....	.....	113 00	
	{ Branch, Varna to Lacon.....	do.....	70.08	.....	6	4,031 50	.....	50 00	
23020	Chicago to Cairo.....	Illinois Central.....	10.55	.....	6	.....	.....	.....	
23021	Dubuque, Iowa, to Centralia, Ill.....	do.....	55	.....	144	74,375 00	.....	225 00	
23022	Joliet to Lake Station, Ind.....	Michigan Central.....	310	.....	144	59,856 00	.....	174 00	
23023	Decatur to East Saint Louis.....	do.....	344	.....	12	1,800 00	.....	40 00	
23024	Peoria to Decatur.....	Toledo, Wabash and Western.....	45	.....	6	90,944 00	.....	167 00	
23025	Hannibal, Mo., to Naples, Ill.....	do.....	112	.....	12	3,433 00	.....	50 00	
23026	{ Branch, Mayville to Pittsfield.....	do.....	68.46	.....	6	6,260 50	.....	131 00	
	{ La Fayette, Ind., to Bloomington, Ill.....	do.....	45.5	.....	6	.....	.....	50 00	
23027	State Line to Warsaw.....	Toledo, Wabash and Western.....	18.40	.....	19	9,777 50	.....	965 00	
23028	Terre Haute, Ind., to East Saint Louis, Ill.....	Toledo, Peoria and Warsaw.....	98.03	.....	19	16,612 50	.....	50 00	
23029	{ Urbana to Havana.....	Indianapolis and Saint Louis.....	223.75	.....	6	33,642 00	.....	178 00	
	{ Branch, White Heath to Decatur.....	Indianapolis, Bloomington and Western.....	189	.....	18	.....	.....	50 00	
23030	East Saint Louis to Du Quoin.....	do.....	102.7	.....	6	6,590 75	.....	45 00	
23031	East Saint Louis to Terre Haute, Ind.....	Saint Louis, Alton and Terre Haute.....	32.35	.....	6	8,544 90	.....	119 00	
23032	{ Saint Louis, Mo., to Evansville, Ind.....	Terre Haute and Indianapolis, Leases of Saint Louis, Vandalia and Terre Haute Railroad.....	71.8	.....	144	33,741 60	.....	204 00	
	{ Branch, McLeansborough to Shawneetown.....	Saint Louis and Southeastern.....	165.4	.....	16	.....	.....	84 00	
23033	Beardstown to Shawneetown.....	do.....	164.75	.....	12	15,095 25	.....	45 00	
23034	Springfield to Gilman.....	Ohio and Mississippi.....	41.25	.....	6	16,079 00	.....	70 00	
23035	Chicago to Milwaukee, Wis.....	Gilman, Clinton and Springfield.....	299.7	.....	6	5,580 00	.....	50 00	
		Chicago, Milwaukee and Saint Paul.....	111.6	.....	6	17,770 00	.....	200 00	
23036	Aurora to Foreston.....	Chicago and Iowa.....	68.88	.....	18	8,000 73	.....	98 00	

\$600 per annum included for ferrage.



## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			<i>Miles.</i>	<i>Miles.</i>		<i>Dollars.</i>	<i>Dollars.</i>	<i>Dollars.</i>	
24017	MICHIGAN—Continued.								
	Detroit to Howard City.....	Detroit, Lansing and Lake Michigan.	164.07	.....	11½	12,844.26	.....	78.00	
24018	Fort Wayne, Ind., to Walton, Mich.	Grand Rapids and Indiana.....	260.55	.....	9½	20,522.90	.....	78.00	
24019	Kalamazoo to South Haven.....	Michigan Central.....	39.74	.....	6	1,987.00	.....	50.00	
24020	Lansing to Fort Wayne Junction, Ind.	Chicago and Lake Huron.....	166.2	.....	6	8,310.00	.....	50.00	
24021	New Buffalo to Pent Water....	Chicago and Michigan Lake Shore.	170.56	.....	14½	.....	.....	82.00	
	Branch, Holland to Grand Rapids.		26.65	.....	12	15,798.12	.....	68.00	
24022	Port Huron to Flint.....	Chicago and Lake Huron.....	66.59	.....	6	3,320.50	.....	50.00	
24023	Allegan to Muskegon.....	Michigan Lake Shore.....	58.37	.....	6	2,918.50	.....	50.00	
24024	Ypsilanti to Bankers.....	Detroit, Hilledale and Southwestern.	63.54	.....	6	3,277.00	.....	50.00	
24025	Jackson to Niles.....	Michigan Central.....	104.57	.....	6	5,437.64	.....	52.00	
24026	Grand Rapids to Morgan Station..	Grand Rapids, Newaygo and Lake Shore.	47.03	.....	6	2,351.50	.....	50.00	
24027	Niles to South Bend, Ind.....	Michigan Central.....	12.2	.....	6	610.00	.....	50.00	
24028	Jonesville to Lansing.....	Lake Shore and Michigan Southern.	60.87	.....	6	3,520.46	.....	58.00	
24029	East Saginaw to Saint Louis.....	Saginaw Valley and Saint Louis.	35.23	.....	6	1,761.50	.....	50.00	
24031	Fort Howard to Lehighburg.....	Chicago and Northwestern.....	180.3	.....	7	16,394.00	.....	50.00	
24032	Muskegon to Big Rapids.....	Chicago and Michigan Lake Shore.	56.04	.....	6	2,548.40	.....	45.00	
24033	Ionia to Stanton.....	Detroit, Lansing and Lake Michigan.	25.31	.....	6	1,265.50	.....	50.00	
24034	Walton to Traverse City.....	Continental Improvement Company.	26.26	.....	6	1,313.00	.....	50.00	
24035	Toledo, Ohio, to Detroit, Mich.....	Toledo, Canada Southern and Detroit.	39.07	.....	14½	5,361.08	.....	92.00	
24036	Grosse Ile to Fayette.....	Chicago and Canada Southern.....	70.3	.....	14½	3,515.00	.....	102.00	
24037	Saint Clair to Richmond.....	Michigan, Midland and Canada.....	10.76	.....	12	838.00	.....	50.00	
24038	Walton to Petoskey.....	Grand Rapids and Indiana.....	71.86	.....	6	4,056.02	.....	57.00	
				3,369.49			393,123.29		
25001	WISCONSIN.								
	Milwaukee to North McGregor, Iowa.	Chicago, Milwaukee and Saint Paul.	197.3	.....	12	24,630.00	.....	125.00	

## REPORT OF THE POSTMASTER-GENERAL.

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## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
			Miles.	Miles.		Dollars.	Dollars.	Dollars.	
	Iowa.—Continued.								
27005	Burlington to Council Bluffs... { Branch, Pacific Junction to East Plattsmouth.	Burlington and Missouri River...	293.14 4		6	76,885 00		250 00 50 00	
27006	Branch, Red Oak to Eastport...	do	50		6			68 00	
27007	Chariton to Leon...	do	37.44		6			50 00	
27008	Creston to Hopkins, Mo...	do	44.4		6	1,872 00		50 00	
27009	Viele Junction to Unionville, Mo...	Burlington and Southwestern...	104.75		6	2,886 00		65 00	
27010	Villisca to Clarinda...	Burlington and Missouri River...	16		6	5,237 50		50 00	
27011	Albia to Northwood...	Central Railroad Company of Iowa...	189.2		6	800 00		50 00	
27012	Keokuk to Viele...	Chicago, Burlington and Quincy...	17		6	12,487 20		66 00	
27013	Clinton to La Crescent Junction, Minn.	Chicago, Burlington and Quincy...	55.75 172.77		6	3,798 00		78 00	
27014	Stauwood to Tipton...	Chicago, Dubuque and Minnesota...	8.81		12	12,234 36		96 00	
27015	Davenport to Missouri River... { Des Moines to Indianola. Branch, Summeret Junction to Winterset.	Chicago, Rock Island and Pacific...	54 264 31.4		6	440 50		50 00	
27016	Washington to Oskaloosa...	do	27.01		6	87,210 00		295 00 270 00	
27017	Wilcox Junction to Leavenworth, Kans.	do	54.01 392.77		6	9,538 00		55 00 50 00	
27018	Davenport to Maquoketa...	Davenport and Saint Paul...	42.76		6	2,700 50		50 00	
27019	Keokuk to Des Moines...	do	182.81		6	27,435 45		85 00	
27020	Farley to Cedar Rapids...	Dubuque and Des Moines...	55.37		6			50 00	
27021	Dubuque to Sioux City...	Illinois Central	327.19		6	12,373 56		53 00	
27022	Waterloo to Monona...	do	80		6	40,890 00		125 00	
27023	Banish to Elkader...	Iowa Eastern	19.59		6	5,840 00		73 00	
27024	Clinton to Anamosa...	Iowa Midland	74.1		6	9,770 50		50 00	
27025	Calmar to Algona...	Chicago, Milwaukee and Saint Paul	127.8		6	3,705 00		50 00	
27026	Conover to Decorah...	do	9.5		6	7,264 60		57 00	
27027	Davenport to Fayette...	Davenport and Saint Paul...	198.33		6	592 50		55 00	
27028	Sabula to Marion...	Chicago, Milwaukee and Saint Paul	87.75		6	6,545 83		51 00	
						4,367 50		50 00	

Pay estimated on 23.01 miles.



Station	City	Company	Rate	Pay estimated.	Do.	Do.
Missouri Valley to Sioux City	Sioux City and Pacific	76	83.4	12,990 00	106 00	
Branch, California Junction to						
Des Moines to Ames	Des Moines and Minnesota	37.12			50 00	
Des Moines to Fort Dodge	Des Moines and Fort Dodge	88.04			53 00	
Central Railroad Company of Iowa	Central Railroad Company of Iowa	19			50 00	
Chicago, Burlington and Quincy	Chicago, Burlington and Quincy	33.97			50 00	
Sioux City and Pembina	Sioux City and Pembina	30.61			50 00	
		3,573.55		373,605 06	50 00	
<b>MINNESOTA.</b>						
Du Luth to Bismarck, Dak	Northern Pacific	289		23,834 80	70 00	
Saint Paul to Breckenridge	Saint Paul and Pacific	219.25		12,378 00	40 00	
Saint Paul to Sauk Rapids	do	78		5,694 00	56 00	
East Saint Cloud Station to Melrose	do	35		1,890 00	73 00	
Saint Paul and Sioux City	Saint Paul and Sioux City	122		12,832 00	54 00	
White Bear Lake to Saint James	Minneapolis and Saint Louis	41		2,050 00	106 00	
White Bear Lake to Stillwater	Lake Superior and Mississippi	155.73		13,859 97	50 00	
White Bear Lake to North McGregor	do	13.2		960 00	50 00	
Minneapolis to North McGregor	Chicago, Milwaukee and Saint Paul	215.7		20,491 50	95 00	
Hastings to Glencoe	do	74.59		2,983 60	40 00	
Winona to La Crescent	do	93		3,750 00	150 00	
Winona to Mason City, Iowa	do	41.38		2,069 00	50 00	
Saint Paul to Winona	do	103.84		21,079 33	203 00	
Saint Peter to Marshall	Winona and Saint Peter	30		4,339 80	65 00	
Winona to Saint Peter	do	78.66		11,540 80	30 00	
La Crosse, Wis., to Winnebago City, Minn.	Southern Minnesota	144.26		11,594 00	80 00	
Manakato to Wells	Central Railroad Company of Minnesota	170.5		1,643 40	68 00	
Saint James to Lemars, Iowa	Sioux City and Saint Paul	123		9,940 00	40 00	
		9,137.39		169,539 39	80 00	
<b>NEBRASKA.</b>						
Council Bluffs, Iowa, to Ogden City, Utah	Union Pacific	1,035.2		351,968 00	340 00	
Plattsmouth to Kearney	Burlington and Missouri River Railroad Company in Nebraska	191		13,370 00	70 00	
Omaha to Herman	Omaha and Northwestern	40.2		2,010 00	50 00	
Omaha to Concord	Burlington and Missouri River Railroad Company in Nebraska	21.5		1,925 50	75 00	
Brownville to Seward	Nebraska	105.85		6,033 45	57 00	
Cret to Beatrice	Burlington and Missouri River Railroad Company in Nebraska	31.76		1,568 00	50 00	
		1,425.51		376,894 95		

**\$313 per annum included for forage.**

B.—Railroad-service as in operation on the 30th of June, 1878—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance. Miles.	Total distance in each State. Miles.	Number of trips per week.	Annual pay. Dollars.	Annual pay in each State. Dollars.	Annual cost per mile on each route.	Remarks.
<b>KANSAS.</b>									
33001	{ Kansas City, Mo., to Cheyenne City, Wyo. Branch, Lawrence to Leavenworth.	Kansas Pacific.....	{ 745 33	.....	9 { 7 {	144,520 00	.....	{ Dollars. 190 00 90 00	
33002	Atchison to Waterville.....	Central Branch Union Pacific.....	100	.....	7	10,000 00	.....	100 00	
33003	{ Lawrence to Coffeyville..... Branch, Cherry Vale to Independence.	Leavenworth, Lawrence and Galveston.....	{ 142.9 10	.....	6 { 6 {	11,859 10	.....	{ 79 00 57 00	
33004	Elwood to Hastings, Nebr.....	Saint Joseph and Denver City.....	297.2	.....	6	13,177 60	.....	59 00	
33005	Kansas City, Mo., to Baxter Springs, Kans.	Missouri River, Fort Scott and Gulf.....	160.2	.....	13	15,379 20	.....	96 00	
33006	Junction City to Parsons.....	Missouri, Kansas and Texas.....	156.5	.....	6	9,077 00	.....	58 00	
33007	{ Atchison to Pueblo, Colo..... Branch, Newton to Wichita.....	Atchison, Topeka and Santa Fé.....	{ 618.56 97.09	.....	6 { 6 {	48,288 30	.....	{ 75 00 70 00	{ Pay estimated on 137.32 miles. Pay from Olathe to Ottawa.
33008	Kansas City, Mo., to Ottawa, Kans.	Leavenworth, Lawrence and Galveston.....	33.3	.....	6	2,797 20	.....	84 00	
33009	Atchison to Lincoln, Nebr.....	Atchison and Nebraska.....	159.98	.....	7	9,136 80	.....	60 00	
33010	Leavenworth to Holton.....	Kansas Central.....	56.5	.....	6	2,825 00	.....	50 00	
33011	Junction City to Clay Centre.....	Junction City and Fort Kearney.....	33.85	.....	6	2,031 00	.....	60 00	
33012	Topeka to Kansas City, Mo.....	Kansas Midland.....	49.84	.....	6	2,492 00	.....	50 00	
33014	Fort Scott to Memphis.....	Fort Scott, Southeastern and Memphis.....	6.92	.....	6	326 00	.....	50 00	
33015	Ottawa to Williamsburgh.....	Kansas City, Burlington and Santa Fé.....	17.38	2,570.12	6	869 00	272,778 20	50 00	Do.
<b>NEVADA.</b>									
45001	Virginia City to Reno.....	Virginia and Truckee.....	51.75	.....	6	3,741 00	.....	72 29	
45002	Palisades to Eureka.....	Eureka and Palisades.....	91.97	143.02	6	4,563 50	6,304 50	50 00	Pay estimated.
<b>CALIFORNIA.</b>									
46001	San Francisco to Ogden City, Utah.	Central Pacific.....	277.5	.....	7	204,457 50	.....	223 00	
46002	{ San Francisco to Solsided..... Branch, Gilroy to Tres Pinos ..	Southern Pacific.....	{ 143.8 90.2	.....	7 { 7 {	12,514 00	.....	{ 80 00 50 00	
46003	Roseville to Redding.....	Central Pacific, (Oregon Division).	152	.....	7	19,000 00	.....	125 00	Pay estimated on 47 miles.

## REPORT OF THE POSTMASTER-GENERAL.

81

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## B.—Railroad-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Corporate title of company carrying the mail.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Annual cost per mile on each route.	Remarks.
	COLORADO TERRITORY—Continued.								
	{ Denver to Black Hawk .....		Miles.	Miles.	7	Dollars.	Dollars.	Dollars.	
	{ Branch, Golden Junction to .....		38.5	.....	7	.....	.....	60 00	
	{ Longmont .....		39	.....	7	4,460 00	.....	50 00	
38004	{ Branch, Forks Creek to Floyd's Hill.	Colorado Central .....	4	.....	7	.....	.....	50 00	
38005	Kit Carson to West Las Animas .....	Arkansas Valley .....	56	419.45	7	3,360 00	26,795 35	60 00	

THOMAS J. BRADY,  
Second Assistant Postmaster General.

C.—Steamboat-service as in operation on the 30th of June, 1876.

Number of route.	State and termini.	Name of contractor.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Remarks.
	MAINE.		Miles.	Miles.		Dollars.	Dollars.	
15	Boston, Mass., to Machias Port, Me.	Eastern Express Company	12		2			One cent on each letter.
246	Rockland to Sullivan.	do			2			Do.
250	Bath to Booth Bay	Eastern Steamboat Company	20	32		700 00		Six times a week during navigation, and six additional trips a week from July 5 to September 20.
	Wiscasset to Booth Bay						700 00	Six times a week from December 1 to March 31.
	NEW HAMPSHIRE.							
316	Alton Bay to Wolfborough.	Boston and Maine Railroad Company	10		6	1,900 00		Three times a week during navigation.
331	Centre Harbor to Meredith Village	Winnipisaukee Steamboat Company	20			650 00		During navigation.
	Wier's Bridge to Wolfborough.		30	60	6		1,850 00	
	MASSACHUSETTS.							
688	Wood's Hole to Nantucket.	Nantucket and Cape Cod Steamboat Company.	30	30		2,500 00		Six times a week for four months; three times a week for eight months.
	RHODE ISLAND.							
811	Fall River, Mass., to New York, N. Y.	Old Colony Steamboat Company	186			10,000 00		Six times a week for nine months; seven times a week for three months.
886	Newport to Wickford.	Newport and Wickford Railroad and Steamboat Company.	12	198	6	6,000 00	16,000 00	
	NEW YORK.							
1389	Burlington, Vt., to Plattsburgh, N. Y.	Champlain Transportation Company	25		6	1,153 00		During navigation.
1694	Geneva to Watkins.	Sauvee Lake Steam Navigation Co.	63		6	3,300 00		For four months.
1790	Lake George to Fort Ticonderoga.	Champlain Transportation Company	40		6	400 00		During navigation.
1823	Penn Yan to Hammondsport.	Lake Keuka Steam Navigation Company.	21	151	6	200 00	4,953 00	
	NEW JERSEY.							
2196	New York, N. Y., to Sandy Hook, N. J.	New Jersey Southern Railroad Co.	19.5		12	1,306 50		Six times a week for eight months; three times a week for four months.
253	New York, N. Y., to Kayport, N. J.	Christy Garity, Jr.	22	41.5		576 84	1,882 79	

C.—Steamboat-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and terminal.	Name of contractor.	Distance. <i>Miles.</i>	Total distance in each State. <i>Miles.</i>	Number of trips per week.	Annual pay. <i>Dollars.</i>	Annual pay in each State. <i>Dollars.</i>	Remarks.
	PENNSYLVANIA.							
2501	Pittsburgh to Greensborough .....	Adam Jacobs .....	88.5	88.5	.....	4,369 94	4,369 94	Six times a week during navigation; three times a week during residue of year.
3521	Baltimore to Queenstown .....	B. S. Ford .....	40	.....	4	750 00	.....	
3696	Baltimore to Pitt's Wharf, Va. ....	Eastern Shore Steamboat Company ..	150	.....	.....	3,000 00	.....	
	WEST VIRGINIA.							
12998	Wheeling to Parkersburgh .....	John Mulrine .....	92	.....	6	7,200 00	.....	
12999	Parkersburgh to Gallipolis, Ohio. ....	Parkersburgh Transportation Com- pany.	89.5	.....	3	5,200 00	.....	
12100	Kanawha Court-House to Gallipolis, Ohio.	A. J. Beckett .....	59	240.5	3	1,300 00	13,700 00	Four times a week to Crisfield, 108 miles; twice a week residue, 42 miles, from May 1 to Dec. 31, and twice a week to Crisfield; once a week resi- duo, from Jan. 1 to April 30.
	VIRGINIA.							
11065	West Point to Baltimore, Md. ....	York River Steamship Company .....	200	.....	3	500 00	.....	
11066	Norfolk to Baltimore, Md. ....	Baltimore Steam Packet Company .....	200	.....	6	18,000 00	.....	
11067	Norfolk to Eastville .....	Old Dominion Steamship Company ..	37	.....	3	3,500 00	.....	
11068	Norfolk to Matthews Court-House ..	..... do .....	60	.....	3	3,000 00	.....	
11069	Norfolk to Richmond .....	John A. Post .....	156	.....	3	4,500 00	.....	
11100	Fredericksburgh to Baltimore, Md. ....	Henry Williams .....	261	976	2	2,600 00	32,100 00	
	NORTH CAROLINA.							
13100	Wilmington to Fayetteville .....	John C. Blocker .....	112	.....	2	2,300 00	.....	
13102	Wilmington to Smithville .....	Merritt Cheek .....	30	.....	6	2,389 00	.....	
13144	Plymouth to Franklin Depot, Va. ....	W. J. Hagan .....	106	.....	3	4,800 00	.....	
13165	Norfolk, Va., to Peplar Branch, N. C. ....	Isaiah Cain .....	100	348	2	1,650 00	11,329 00	
	SOUTH CAROLINA.							
14099	Charleston to Moultrieville .....	Mount Pleasant Ferry Company .....	6	.....	7	500 00	.....	

14194	Charleston to Edisto Island	Peter Toglio	39	45	1	1,000 00	1,500 00	Once a week on 40 miles; six times a week on 11 miles.	
15184	GEORGIA.	J. M. Elliott	153		2	3,600 00			
15286	Rome to Gadsden, Ala. Traders Hill to Ferdinand, Fla.	William Mangum	51	206		1,969 00	5,569 00		
16017	FLORIDA.	C. R. Griffing & Co.	35		2	500 00		Twice a week for four months; once a week for eight months.	
16018	New York, N. Y., to Galveston, Tex.	C. H. Mallory & Co.	2,036		1	10,400 00			
16019	Cedar Keys to Key West.	James McKay	470		1	18,000 00			
16021	Enfauila, Ala., to Chattahoochee, Fla.	Samuel J. Whiteside	130		2	3,800 00			
16022	Chattahoochee to Apalachicola	Andrew J. Parlin	151		1	4,900 00			
16023	Palatka to Jacksonville.	Jacob Brock	192		6	8,000 00			
16024	Palatka to Sanford.	do	143		3	5,915 94			
16025	Palatka to Okahumpka	S. J. Bonknight	275	3,349		2,400 00	55,915 94		
18020	MISSISSIPPI.	S. H. Parisot	262	262	2	4,800 00	4,800 00		
30053	LOUISIANA.	Leathers, Tobin & Cannon	408		3	35,000 00			Three times a week for six months; twice a week for residue of year. Three times a week for eight months; twice a week for residue of year.
30055	New Orleans to Vicksburg, Miss.	Milton E. Muncey	119		2	3,000 00			
30057	New Orleans to Hope Villa.	Monroe P. Young	74		6	6,600 00			
30058	Brashear to New Iberla.	John J. Brown	170		2	10,000 00			
30059	New Orleans to Saint Francisville	John J. Brown	170		2	10,000 00			
30099	New Orleans to Covington	Mandeville and New Orleans Daily Packet Company.	62		3	3,950 00			
30100	New Orleans to Port Eads	J. B. Price	{ 116 45 }	994	3 } 5,056 96 1 }		63,606 96		
31095	TEXAS.	Joseph T. Recalde.	{ 114 160 }		3 }	17,950 00		Three times a week for six months; twice a week for residue of year. Three times a week for eight months; twice a week for residue of year.	
31096	Indianola to Point Isabel	Charles Morgan.	225		2 }	50,000 00			
31097	Galveston to Brashear, La.	do	185			10,000 00			
31098	Galveston to Indianola	David P. Thompson	93		2	7,360 00			
31099	Galveston to Liberty	James B. Price.	118	835	2	7,000 00	92,310 00		
31100	Sabino Pass to Wicks Bluff	do							
29100	ARKANSAS.	James Lee, Jr.	112		3	1,000 00			
29101	Memphis, Tenn., to Friar's Point, Miss.	John A. Scudder.	240		3	17,000 00			
29102	Memphis, Tenn., to Chicot, Ark. Chicot to Vicksburg, Miss.	do	189		3	18,000 00			

C.—Steamboat-service as in operation on the 30th of June, 1876—Continued.

Number of route.	State and termini.	Name of contractor.	Distance.	Total distance in each State.	Number of trips per week.	Annual pay.	Annual pay in each State.	Remarks.
	ARKANSAS—Continued.		Miles.	Miles.		Dollars.	Dollars.	
22103	White River to Pine Bluff .....	John D. Adams .....	182.5	182.5	2	5,000 00	5,000 00	
22104	Pine Bluff to Little Rock .....	do .....	102	102	2	2,000 00	2,000 00	
22105	White River to Jacksonport .....	M. R. Harry .....	356	356	2	5,000 00	5,000 00	
				1,164.5			48,000 00	
	MISSOURI.							
22099	Saint Louis to Grand Tower, Ill. ....	John A. Snidder .....	125	125	3	1,250 00	1,250 00	
22100	Saint Louis to Memphis, Tenn. ....	do .....	430	430	3	25,000 00	25,000 00	
				575			26,250 00	
	TENNESSEE.							
19098	London to King's Creek .....	R. S. & J. N. Lowery .....	49	49	6	3,950 00	3,950 00	
19099	Chattanooga to King's Creek .....	C. W. Coker .....	110	110	2	2,993 34	2,993 34	
				159			6,943 34	
	KENTUCKY.							
20097	Louisville to Evansville, Ind. ....	Sherley & Hite .....	202	202	6	15,000 00	15,000 00	
20098	Evansville, Ind., to Cairo, Ill. ....	Evansville, Cairo and Memphis Packet Company .....	202	202	6	15,000 00	15,000 00	
20099	Bowling Green to Evansville, Ind. ....	Green and Barren River Navigation Company .....	225	225	2	4,800 00	4,800 00	
20100	Paducah to Eastport, Miss. ....	William G. Brown .....	265	265	2	6,000 00	6,000 00	
				694			40,800 00	
	OHIO.							
9061	Portsmouth to Cincinnati .....	David Gibson .....	127.75	127.75	3	4,500 00	4,500 00	
9062	Cincinnati to Mayaville, Ky. ....	do .....	65.5	65.5	3	2,000 00	2,000 00	
9063	Portsmouth to Gallipolis .....	B. Butterfield .....	36.65	36.65	3	7,300 00	7,300 00	
			51.35	51.35	6			
				241.25			13,800 00	
	MICHIGAN.							
24094	Manitowish to Milwaukee, Wis. ....	Engelman Transportation Company .....	100	100	6	4,100 00	4,100 00	From April 1 to December 1.
24096	Petoskey to Mackinac .....	Grand Rapids and Indiana Railroad Company. ....	55	55	6	1,300 00	1,300 00	From July 1 to September 30.



31097	Detroit to Sault de Ste. Marie.....	350	.....	2	.....	140 00	.....	From June 15 to November 15.
31099	Hay City to Alpena.....	143	.....	6	.....	10,000 00	.....	From April 16 to November 15.
31100	Grand Haven to Milwaukee, Wis.....	85	.....	6	.....	2,340 00	.....	From May 1 to October 31.
			793				14,380 00	
46101	CALIFORNIA.							
46102	San Francisco to Portland, Oreg.....	670	.....	1	.....	95,000 00	.....	
46273	San Francisco to Sacramento City.....	230	.....	6	.....	8,000 00	.....	
46275	San Francisco to San Quentin.....	12	.....	7	.....	1,200 00	.....	
	Rowlands to Rowlands.....	100	.....		.....	3,000 00	.....	Six times a week for six months; once a week for residue of year.
			1,012				37,200 00	
44101	OREGON.							
44102	Portland to Astoria.....	120	.....	6	.....	14,906 83	.....	
	Portland to The Dalles.....	120	.....	6	.....	15,535 00	.....	
			240				30,441 83	
43101	WASHINGTON TERRITORY.							
43108	Olympia to Victoria, British Columbia.....	20	.....	3	.....	94,313 00	.....	
43115	Seattle to Sk-home.....	130	.....	2	.....	3,600 00	.....	
43132	Port Townsend to Semialmo.....	143	.....	1	.....	4,900 00	.....	
	Portland, Oreg., to Sitka, Alaska.....	129	.....	1	.....	34,800 00	.....	One trip per month.
		1,315	.....		.....		67,613 00	
			1,757					

THOS. J. BRADY,  
Second Assistant Postmaster-General.

D.—Table showing the increase and decrease in mail-transportation and cost during the year ended June 30, 1876.

States and Territories.	CELERITY, CERTAINTY, AND SECURITY.				STEAMBOAT.				RAILROAD.				Total annual transportation.		Total annual cost.	
	Length of routes.		Cost.		Length of routes.		Cost.		Length of routes.		Cost.		Increase.	Decrease.	Increase.	Decrease.
	Increase.	Decrease.	Dollars.	Miles.	Increase.	Decrease.	Dollars.	Miles.	Increase.	Decrease.	Dollars.	Miles.				
Maine.....	22		2,021	39			700	69			9,512	67,438			12,233	
New Hampshire.....	102		1,452				5,758				2,558				4,207	
Vermont.....	34		1,509				2,151	35			27				1,452	
Massachusetts.....	235		1,092				687	1			1,618				4,409	
Rhode Island.....	16		9,643				27				25,864				187,881	
Connecticut.....	34		9,249				800	33			39,305				4,908	
New York.....	314		7,537				2,400	308			3,961					
New Jersey.....	8		2,403				1,775	64			965					
Pennsylvania.....	203		10,453				3,744	111			31,877					
Delaware.....	3		1,043				40	1			98,379				52	
Maryland.....	93		2,307				18	40			9,727					
West Virginia.....	5		3,825				8,641	167			13,985					
Virginia.....	912		12,889				10,317	205			24,180					
North Carolina.....	406		1,095				2,700	244			31,877					
South Carolina.....	108		10,317				27,224	225			9,727					
Georgia.....	82		12,889				18,990	49			9,727					
Florida.....	253		1,095				18,990	3			9,727					
Alabama.....	97		1,095				18,990	28			9,727					
Mississippi.....	40		1,095				18,990	21			9,727					
Louisiana.....	243		1,095				18,990	21			9,727					
Texas.....	53		1,095				18,990	21			9,727					
Arkansas.....	1,032		1,095				18,990	21			9,727					
Missouri.....	13		1,095				18,990	21			9,727					
Illinois.....	356		1,095				18,990	21			9,727					
Indiana.....	51		1,095				18,990	21			9,727					
Ohio.....	39		1,095				18,990	21			9,727					
Michigan.....	354		1,095				18,990	21			9,727					
Wisconsin.....	182		1,095				18,990	21			9,727					
Iowa.....	347		1,095				18,990	21			9,727					
Minnesota.....	55		1,095				18,990	21			9,727					
Nebraska.....	22		1,095				18,990	21			9,727					
Kansas.....	1,115		1,095				18,990	21			9,727					

Nevada	196	1,441						91	5,718		6,917	53,454	4,975
California	176	15,072						922	16,022			8,556	9,775
Oregon								1	26				9,775
Washington Territory	125												9,775
Idaho Territory	214												9,775
Montana Territory	315												9,775
Dakota Territory	118												9,775
Wyoming Territory	68												9,775
Utah Territory	46												9,775
Colorado Territory	110												9,775
Indian Territory	621												9,775
New Mexico Territory	81												9,775
Arizona Territory	427												9,775
Total	6,242	497,812	973	1,878	27,140	104,805	2,776	511	423,060	96,444	3,769,417	1,331,925	373,853
	3,677	96,632		973	973	27,140	511		96,444		1,331,925		373,853
Increase													
Decrease	2,565			905		77,665	2,265		396,616		2,447,492		152,229

THOMAS J. BRADY,  
Second Assistant Postmaster-General.

E.—Table showing the weight of the mails, the speed with which they are conveyed, the accom on railroad-routes in States in which the contract-term expired June 30, 1876, and also in other pay in accordance with the act of March 3, 1873; and used also in accordance with the act

ABBREVIATIONS.—f. f., fixtures and furniture; f. f. c., fixtures and furniture complete; m. c., mail-line; d. l., double line; t. l., triple line; m., miles; r. a., route-agents; m. m., mail-messengers. A the "Remarks" column refer to the order of the routes in this table.

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
1	Ohio...	9008	21007	Elyria, Millbury .....	Lake Shore and Michigan Southern.	<i>Miles.</i> 74.98	32, 28
2	N. Y. ...	1201	.....	New York, Dunkirk .....	Erie .....	459	35
3	N. J. ...	2103	7004	New York, West Philadelphia.	Pennsylvania .....	90	28
4	Ohio...	9049	21045	Toledo, Elkhart .....	Lake Shore and Michigan Southern.	133.6	32, 28
5	N. Y. ...	1241	.....	Elkhart, Chicago .....	.....do .....	101	32, 28
6	N. Y. ...	1217	.....	Albany, Buffalo .....	New York Central and Hudson River.	298	45, 30
7	N. Y. ...	1211	.....	New York, Albany .....	.....do .....	144	45, 30
8	N. Y. ...	1211	.....	Albany, Troy .....	.....do .....	6	30
9	N. Y. ...	1241	.....	{ Buffalo, Elyria .....	Lake Shore and Michigan Southern.	{ 210.2 8.5 }	{ 32, 28 }
				{ Millbury, Toledo .....			
10	N. Y. ...	1241	.....	Buffalo, Chicago .....	.....do .....	542	32, 28
11	N. Y. ...	1241	.....	{ Elyria, Millbury .....	.....do .....	{ 79.3 143 }	{ 32, 28 }
				{ Toledo, Elkhart .....			
12	Pa. ....	2401	.....	Philadelphia, Pittsburgh....	Pennsylvania .....	353.6	28

modulations for mails and agents, the trips per week, and the rates of pay per mile per annum, States and Territories, the returns having been obtained with a view to the re-adjustment of the of July 12, 1876, in the case of re-adjustments taking effect on and after July 1, 1876.

catchers: r. p. o., railway post-office; apt., apartment; b. c., baggage-car; l., line or lines; s. l., single number followed by an asterisk (\*) shows the equivalent in round trips. The figures in parentheses in

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.					
2177501	605, 064	2782563	2727772	45, 462	r. p. o., 45 by 9, (average,) 4 l., 18 by 9, 4 l.; fast-mail, 4 l.—45 by 9, 45 by 9, 60 by 9, 60 by 9.	13	\$755 00	60 days, from Dec. 1, 1875; average speed, 32 m. fast-mail; 28 m. residue.	1
654 745	403, 990	1058335	364, 911	6, 082	r. p. o., 50 by 10, f. f. c., d. l. to Hornellsville, 332 m.; s. l. residue, 127 m.; r. a. apt., 15.11 by 10.4, f. f., s. l. 67 m.; 12.8 by 6.8, f. f., s. l. 39 m.	17½	705 00	60 days, from Dec. 1, 1875.	2
2157352	1078710	2326062	2977649	49, 627	r. p. o., 40 by 8.7, f. f. c., 3 l.; 58.6 by 8.5, f. f. c., 1 l.; tender, 29 by 7.9, f. f. c., 1 l.; r. a. apt., (average,) 15.4 by 6.6, 1 l. through r. a. apt., 8 by 6.4, 1 additional to Monmouth Junction, 42 m.	40½	628 00	Main route; branches 8-8, (146,) 835; 60 days, from Dec. 1, 1875.	3
1211574	528, 535	2340529	2228749	37, 147	r. p. o., 5 by 9, (average,) 1 l.; fast-mail, 4 l.—45 by 9, 45 by 9, 60 by 9, 60 by 9.	13	625 00	60 days, from Dec. 1, 1875; average speed, 32 m. fast-mail; 28 m. residue.	4
-----	-----	-----	2244739	37, 412	r. p. o., 36 by 9, 1 l.; 45 by 9, (average,) 1 l.; fast-mail, 4 l.—45 by 9, 45 by 9, 60 by 9, 60 by 9.	17½	615 00	60 days, from Dec. 1, 1875; average speed, 32 m. fast-mail; 28 m. residue. Part; residue \$590, \$485, (9, 11)	5
3146567	1039930	4186517	3364475	56, 071	r. p. o., fast-mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9; and 1 l. 47 by 9, (average.)	34	602 00	60 days, from Dec. 1, 1875; average speed, 45 m. fast-mail; 30 m. residue.	6
9697830	799, 734	3497564	3159723	52, 662	r. p. o., fast-mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9; and 1 l. 47 by 9, (average.)	47*	597 00	60 days, from Dec. 1, 1875. Part; residue \$597, (8.) Average speed, 45 m. fast-mail; 30 m. residue.	7
-----	-----	-----	108, 055	1, 801	-----	27	597 00	60 days, from Dec. 1, 1875. Part; residue \$597, (7.)	8
-----	-----	-----	3066186	51, 102	(r. p. o., 38 by 9, (average,) 1 l.; 45 by 9, (average,) 1 l.; fast-mail, 4 l.—45 by 9, 45 by 9, 60 by 9, 60 by 9, Buffalo to Cleveland, 184.5 m.; 38 by 9, (average,) 1 l.; 18 by 9, 1 l.; 45 by 9, (average,) 1 l.; fast-mail, 4 l.—45 by 9, 45 by 9, 60 by 9, 60 by 9, Cleveland to Elyria, 25.7 m., and Millbury to Toledo, 8.5 m.)	17½	590 00	{ 60 days, from Dec. 1, 1875. Average speed, 32 m. fast-mail; 28 m. residue. Part; residue, \$615, \$485, (5, 11.) 34.2 m. at \$615.	9
6793071	2213808	8953179	1709576	23, 492	See parts, (5, 9, 11.)	17½	553 17	60 days, from Dec. 1, 1875; average rate of pay 184.5 m. at \$590; 135.2 m. at \$615; 222.3 m. at \$485.	10
-----	-----	-----	132, 950	2, 215	(r. p. o., 38 by 9, (average,) 1 l.; 45 by 9, (average,) 1 l.; 18 by 9, 1 l., Elyria to Millbury, 79.3 m.; 38 by 9, 1 l.; 36 by 9, 1 l., Toledo to Elkhart, 143 m.)	17½	485 00	{ 60 days, from Dec. 1, 1875; average speed, 32 m. fast-mail; 28 m. residue. Part; residue \$615, \$590, (5, 9.)	11
5020295	1129295	2210290	1802446	20, 027	r. p. o., 46.5 by 8.9, f. f. c., s. l.; r. a. apt., 10.11 by 8.7, f. f., s. l.	36	438 00	90 days, from Oct. 1, 1874.	12

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route. Miles.	Miles per hour.
13	Pa . . . .	2401	8001	Philadelphia, Pittsburgh . . . .	Pennsylvania . . . . .	353.6	28
14	Md . . . .	3503	.....	Baltimore, Washington . . . . .	Baltimore and Ohio . . . . .	40	28
15	Md . . . .	3503	.....	.....do . . . . .	.....do . . . . .	40	28
16	Ohio . . . .	9032	21028	Cincinnati, Parkersburgh . . . .	Marietta and Cincinnati . . . .	195.15	30
17	N. Y. . . .	1208	.....	Buffalo, Hornellsville . . . . .	Erie . . . . .	91	30
18	Md . . . .	3504	10003	Baltimore, Wheeling . . . . .	Baltimore and Ohio . . . . .	393	24
19	W. Va . . . .	13002	.....	Grafton, Parkersburgh . . . . .	.....do . . . . .	104.58	29
20	Md . . . .	3514	10013	Bay View Junction, n. o., (Baltimore,) Washington.	Baltimore and Potomac . . . . .	46.1	26
21	Neb. . . . .	31001	.....	Omaha, Ogden City . . . . .	Union Pacific . . . . .	1,032.4	25
22	Ohio . . . .	9002	.....	Pittsburgh, Chicago . . . . .	Pittsburgh, Fort Wayne and Chicago.	469.5	25
23	N. J. . . .	2101	7001	New York, Easton . . . . .	Central, of New Jersey . . . . .	74	27
24	Ind . . . .	22003	22003	Indianapolis, Cincinnati . . . .	Indianapolis, Cincinnati and La Fayette.	113.50	28
25	Ohio . . . .	9001	21001	Bellaire, Columbus . . . . .	Central Ohio . . . . .	137½	.. . .
26	Ohio . . . .	9001	21001	Bellaire, Newark . . . . .	.....do . . . . .	104½	25
27	Ohio . . . .	9001	21001	Newark, Columbus . . . . .	.....do . . . . .	33	25
28	Ind . . . .	22028	22029	La Fayette, Kankakee . . . . .	Cincinnati, La Fayette and Chicago.	75.75	35
29	Ind . . . .	22005	22005	Indianapolis, La Fayette . . . .	Indianapolis, Cincinnati and La Fayette.	65.62	28
30	Ind . . . .	22010	22010	Cincinnati, East Saint Louis . . .	Ohio and Mississippi . . . . .	341	26.2
31	Ky . . . .	20005	20005	Louisville, Nashville . . . . .	Louisville and Nashville . . . . .	126.6	20.5
32	Tenn . . . .	13002	19502	Bristol, Chattanooga . . . . .	East Tennessee, Virginia and Georgia.	242.7	20

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
1649487	717, 765	2367252	1744696	29, 078	r. p. o., 58.6 by 8.5, f. f. c., 1 l.; 46 by 8.5, f. f. c., 1 l.; tender, 29 by 7.9, 1 l.; r. a. apt., (average,) 11.6 by 8, f. f., a. l.	37½*	\$417 00	60 days, from Dec. 1, 1875.	13
-----	-----	-----	-----	26, 694	r. p. o., 52.4 by 9.6½, f. f., d. l.	54	375 00	Weight for 30 days, from Oct. 5, 1874, and 90 days on night-line r. p. o., from Dec. 1, 1875.	14
358, 930	125, 164	484, 084	460, 869	15, 362	r. p. o., 52.4 by 9.6½, f. f., a. l., from April 19, 1874.	48	375 00	In October, 1874.....	15
119, 155	155, 724	274, 879	212, 881	7, 096	r. p. o., 52.4 by 9, f. f., a. l.; apt., (no r. a.,) 14 by 9, a. l.	14	373 00	-----	16
96, 035	81, 741	177, 776	100, 230	1, 670	14 by 9.2, 12.6 by 9.10, f. f., a. l.	32½*	362 50	60 days, from Dec. 1, 1875.	17
640, 707	339, 697	980, 404	501, 633	8, 360	r. p. o., 52.4 by 9.7, f. f. o., d. l. to Grafton, 294 m.; a. l. residue, 99 m.; r. a. apt., 17 by 8.7½, Baltimore and Harper's Ferry, 96 m., and between Grafton and Wheeling, 99 m.	27½*	360 00	60 days, from Dec. 1, 1875; 99 m. at \$330.	18
293, 639	150, 210	433, 869	390, 372	6, 506	r. p. o., 52.4 by 9.7, f. f. o., a. l.	19	338 00	60 days, from Dec. 1, 1875.	19
1023533	682, 496	1706051	1667852	18, 754	r. p. o., 46.10 by 9, f. f., d. l.; r. a. apt., 14.9 by —, f. f., a. l.	29*	327 00	90 days, from Oct. 1, 1875; 3.5 m. increase.	20
392, 733	131, 897	524, 630	460, 466	15, 348	r. p. o., (say) 50 by 9.9, f. f. c., a. l.	7	315 00	r. p. o., with platforms, 54.5 by 9.9. In February, 1876.	21
322, 543	237, 968	560, 531	172, 663	5, 755	24.3 by 8.11½, 21 by 8.9, f. f., d. l. to Homewood, 35 m.; a. l. residue, 43½ m.	22½*	300 00	In August, 1875. Additional fast-mail from Sept. 12, 1875, 7 times per week.	22
82, 478	49, 845	132, 323	78, 414	2, 613	14 by 7, d. l.	49*	300 00	-----	23
73, 546	156, 155	231, 701	192, 463	6, 415	r. p. o., 50 by 9.5, f. f. o., a. l.; r. a. apt., 12 by 7.6, f. f. c., a. l.	18	268 00	-----	24
231, 473	181, 236	432, 709	-----	-----	-----	-----	267 00	60 days, from Dec. 1, 1875. See parts, (26, 27.)	25
-----	-----	-----	346, 776	5, 779	r. p. o., 50 by 8, f. f., a. l.	20	267 00	60 days, from Dec. 1, 1875. Part; residue \$267, (27.) See whole route, (25.)	26
-----	-----	-----	63, 670	1, 061	In b. c.; no r. a.	20	267 00	60 days, from Dec. 1, 1875. Part; residue \$267, (26.) See whole route, (25.)	27
127, 261	98, 811	226, 072	216, 199	7, 206	r. p. o., 50 by —, f. f. c., a. l.; r. a. apt., 12 by 7, f. f. c., a. l.	13	262 00	-----	28
117, 619	82, 315	199, 934	188, 469	6, 282	r. p. o., 50 by 9.5, f. f. c., a. l.; r. a. apt., 12 by 7.6, f. f., a. l.	22*	262 00	-----	29
187, 416	108, 191	295, 607	170, 095	5, 669	r. p. o., 50 by 10, 50 by 10, 50 by 10, 45 by 10, 41 by 10, f. f., a. l.	13½*	254 00	72.40 m. at \$279.....	30
331, 301	194, 348	455, 649	250, 998	8, 366	r. p. o., 45 by 9.7, f. f., a. l.—to Bowling Green, 113.5 m.; r. a. apt., 14.9 by 9.7, f. f., 1½ l. to Bowling Green, 113.5 m., and 2½ l. residue, 73.1 m. Additional r. a. apt., 14 by 7.4, f. f., a. l. to Lebanon Junction, 30 m.	18½*	247 50	Average speed. 73.1 m. at \$217.50.	31
101, 689	68, 703	170, 388	120, 713	4, 023	r. p. o., 39.7 by 8.9½, f. f. o., a. l.	14	244 00	Main route; branch \$100, (120.)	32

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
33	Ohio	9046	21042	Cleveland, Cincinnati .....	Cleveland, Columbus, Cincinnati and Indianapolis.	<i>Miles.</i> 245.25	36
34	Ohio	9051	21047	Chicago, O., Chicago, Ill. ....	Baltimore and Ohio, (operating Baltimore, Pittsburgh and Chicago Railroad.)	271.53	35
35	Cal	46001	.....	San Francisco, Ogden .....	Central Pacific .....	880.96	21
36	Ohio	9036	21032	Columbus, Pittsburgh .....	Pittsburgh, Cincinnati and Saint Louis.	193	31
37	Mo	28011	.....	Sedalia, Denison .....	Missouri, Kansas and Texas ..	447	22
38	Ohio	9002	21002	Pittsburgh, Homewood .....	Pittsburgh, Fort Wayne and Chicago.	30.7	.....
39	Mo	28014	.....	Hannibal, Sedalia .....	Missouri, Kansas and Texas ..	142.88	20
40	Va.	4409	11008	Richmond, Petersburg .....	Richmond and Petersburg .....	24.07	27
41	Ohio	9031	21027	Cincinnati, Xenia .....	Pittsburgh, Cincinnati and Saint Louis, (Little Miami division.)	65.96	28
42	Ohio	9016	21014	Columbus, Xenia .....	Columbus and Xenia .....	55	28
43	Ohio	9002	.....	Pittsburgh, Chicago .....	Pittsburgh, Fort Wayne and Chicago.	469.5	27
44	Ohio	9002	21002	.....do .....	.....do .....	469.5	27
45	Ind	22002	22002	Indianapolis, Terre Haute ..	Terre Haute and Indianapolis.	73	30
46	Tenn	19004	19004	Stevenson, Chattanooga .....	Nashville and Chattanooga ..	39	25
47	Ga.	15002	15002	Atlanta, Chattanooga .....	Western and Atlantic .....	138.47	23
48	Tenn	19004	19004	Stevenson, Chattanooga .....	Nashville and Chattanooga ..	39	.....
49	Ill	23031	.....	East Saint Louis, Terre Haute.	Terre Haute and Indianapolis	165.40	30
50	Va.	4410	11009	Petersburgh, Weldon .....	Petersburgh .....	65.51	30
51	Ohio	9051	21047	Chicago, O., Chicago, Ill. ....	Baltimore and Ohio, (operating Baltimore, Pittsburgh and Chicago Railroad.)	271.53	35
52	Ky	30004	30004	Cincinnati, Louisville .....	Louisville, Cincinnati and Lexington.	110½	27.5
53	Ill	23010	.....	Camp Point, Quincy .....	Chicago, Burlington and Quincy.	22	25
54	Ill	23010	.....	Galesburgh, Camp Point .....	.....do .....	78	25
55	Ohio	9030	21026	Cincinnati, Dayton .....	Cincinnati, Hamilton, and Dayton.	60.45	.....



are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c. of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Feet and inches.</i>				
360,591	173,891	534,482	232,454	7,748	r. p. o., 39.2 by 9.2, f. f., d. l. to Gallion, 80 m.; a. l. residue, 165.25 m.	19	\$37 00	80 m. at \$362.....	33
301,945	142,326	444,271	283,048	4,717	r. p. o., 50 by 8, f. f., a. l.; r. a. apt., 20 by 8, f. f., a. l.	14	235 00	60 days, from Dec. 10, 1875.	34
172,607	314,886	487,493	343,018	11,434	r. p. o., 55.1½ by 8.9, f. f. c., a. l.	7½	233 60	In February & March, 1876. 3.46 m. increase.	35
246,992	230,112	477,104	225,222	16,420	r. p. o., 50.5 by 9.2, f. f., a. l.	20	230 00	60 days, from Dec. 1, 1875. Main route; branch \$50, (306.)	36
93,205	39,436	132,641	84,297	2,809	r. p. o., (say) 51.2 by 9.10, f. f., a. l.	7	223 00	In July, 1875; r. p. o., "over all," 57.7.	37
87,683	39,525	127,208	127,208	2,120	.....		219 00	Part; residue \$209, (44.) Weight carried for 60 days, from Dec. 1, 1875, by Erie and Pittsburgh trains.	38
60,249	23,809	84,058	64,057	2,135	r. p. o., (say) 51.2 by 9.10, f. f., a. l.	7	215 00	In July, 1875; r. p. o., "over all," 57.7.	39
122,665	55,745	238,430	235,665	3,927	r. p. o., 42 by —, f. f. c., d. l.	13	213 00	60 days, half from June 1, 1875, and residue from Jan. 24, 1876. \$150 m. m.	40
174,323	415,390	589,713	351,446	9,190	r. p. o., 50.5 by 9.2, f. f., a. l.; r. a. apt., 19.7 by 8.6, f. f., a. l.	20	210 00	60 days, from Dec. 1, 1875. Part; residue \$50, (354.)	41
411,540	143,133	554,673	345,819	9,096	r. p. o., 50.5 by 9.2, f. f., a. l.; r. a. apt., 19.7 by 8.6, f. f., a. l.	13	210 00	60 days, from Dec. 1, 1875.	42
104,534	298,255	402,789	226,579	6,961	24.3 by 11½, 21 by 8.9, f. f., d. l. to Homewood, 35 m.; a. l. residue.	25½	209 00	90 days, from Oct. 1, 1874. 35 m. at \$219.	43
659,414	315,324	974,738	277,141	4,619	24.3 by 11½, 21 by 8.9, f. f., d. l. to Homewood, 35 m.; a. l. residue.	29½	209 00	60 days, from Dec. 1, 1875. 35 m. at \$219, (38.)	44
347,214	194,724	541,938	344,150	9,069	r. p. o., 50.6 by 9.3, f. f. c., a. l.; r. a. apt., 19.7 by 7.7, f. f., d. l.	22½	208 00	60 days, from Dec. 1, 1875.	45
.....	.....	.....	123,202	4,106	12.6 by 8.8, f. f., d. l.	19	205 00	Part; residue \$145, (91.) With lap service. See whole route, (50.)	46
80,074	114,933	195,012	143,333	2,811	r. p. o., 40 by 9, f. f., a. l.; r. a. apt., 13.4 by 8.4, f. f., a. l.	14	205 00	51 days, 21 from Mar. 15, and 30 from May 15, 1876.	47
16,921	32,026	48,947	49,067	1,635	.....		205 00	Lap service performed by Memphis and Charleston Railroad Company; paid for to Nashville and Chattanooga Railroad Company.	48
176,233	354,839	531,072	453,629	7,560	r. p. o., 50.6 by 9.9, f. f. c. and m. c., a. l.; r. a. apt., 19 by 7, f. f., a. l.	19	204 00	60 days, from Dec. 1, 1875.	49
161,631	48,955	210,586	200,493	3,342	r. p. o., 42.4 by 8.10, f. f. c., d. l.	13	204 00	60 days, half from June 1, 1875, and residue from Jan. 24, 1876.	50
61,341	42,030	103,371	84,038	2,801	r. p. o., 50 by 8, f. f., a. l.; r. a. apt., 20 by 8, f. f., a. l.	14	203 00	In June, 1875	51
214,523	84,409	298,932	150,285	8,362	9.6 by 2, f. f., a. l., and b. o.	18	200 0	.....	52
.....	.....	.....	236,840	7,894	r. p. o., 44.11 by 9.6, f. f. c. and m. c., a. l.; r. p. o. lap, 50.8 by —, f. f., a. l.	12	190 0	Part, lap. See residue, (54.)	53
.....	.....	.....	95,174	3,172	r. p. o., 44.11 by 9.6, f. f. c. and m. c., a. l.	12	190 00	Part; see residue, (53.)	54
81,874	45,876	127,750	.....	.....	.....	187 50	33.92 m at \$120. S. e parts, (56, 83.)	.....	55

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Terminal.	Corporate title of company carrying the mail.	Length of route. <i>Miles.</i>	Miles per hour.
56	Ohio	9030	21096	Cincinnati, Hamilton .....	Cincinnati, Hamilton and Dayton.	24.53	26
57	Ky	20008	20008	Bowling Green, Guthrie ....	Louisville and Nashville.....	51	24
58	Ohio	9018	21016	Gallion, Indianapolis .....	Cleveland, Columbus, Cincinnati and Indianapolis.	204	31
59	Ill	23028	.....	Terre Haute, East Saint Louis.	Indianapolis and Saint Louis	189	30
60	Tenn	19009	19009	Guthrie, Paris .....	Louisville and Nashville.....	82.5	24
61	Ky	20018	20018	Cincinnati Junction, Louisville and Nashville Junction.	Louisville, Cincinnati and Lexington.	4.13	12
62	Mias	18001	18001	Canton, Cairo .....	New Orleans, Saint Louis and Chicago.	342.98	20
63	Ill	23028	.....	Terre Haute, East Saint Louis.	Indianapolis and Saint Louis	189	29
64	Tenn	19010	19010	Milan, Paris .....	Louisville and Nashville.....	43.5	25
65	Ind	22018	22019	Jeffersonville, North Vernon	Ohio and Mississippi.....	53.50	24.5
66	N. C	13002	13002	Weldon, Wilmington .....	Wilmington and Weldon.....	163.07	24
67	Ohio	9017	21015	Columbus, Indianapolis .....	Columbus, Chicago and Indiana Central.	188	31
68	N. C	13004	13004	Greensborough, Charlotte....	Richmond and Danville.....	93	21½
69	Ala.	17005	17005	Memphis, Stevenson .....	Memphis and Charleston.....	271.5	23
70	Ohio	9020	21018	Portsmouth, Reed's Mills ..	Marietta and Cincinnati ..	56	25
71	S. C	14002	14002	Columbia, Wilmington .....	Wilmington, Columbia and Augusta.	191.78	.....
72	S. C	14002	14002	Florence, Wilmington .....	do .....	109.70	.....
73	Tex.	31003	.....	Houston, Denison City .....	Houston and Texas Central...	337.55	20
74	Ohio	9011	21010	Sandusky, Newark .....	Baltimore and Ohio, (lessee Sandusky, Mansfield and Newark.)	116	.....
75	Ohio	9011	21010	Chicago, O., Newark .....	do .....	28	30
76	Ohio	9011	21010	Sandusky, Newark .....	do .....	116	.....
77	Ohio	9007	21006	Cleveland, Wellsville .....	Cleveland and Pittsburgh....	102.36	30
78	Ohio	9011	21010	Chicago, O., Newark .....	Baltimore and Ohio, (lessee Sandusky, Mansfield and Newark.)	28	30
79	Ohio	9011	21010	Sandusky, Chicago, O. ....	do .....	28	30
80	Ohio	9011	21010	do .....	do .....	28	30
81	N. Y	1222	.....	Troy, Saratoga Springs .....	Delaware and Hudson Canal Company.	32.81	30
82	Ala	17012	17012	Mobile, Montgomery .....	Mobile and Montgomery.....	179	24
83	Ohio	9030	21026	Hamilton, Dayton .....	Cincinnati, Hamilton and Dayton.	33.92	26
84	N. Y	1221	.....	Eagle Bridge, Rutland .....	Delaware and Hudson Canal Company.	62.5	30
85	Ohio	9027	21023	Dayton, Toledo .....	Dayton and Michigan .....	142.96	23
86	N. Y	1220	.....	Saratoga Springs, Castleton.	Delaware and Hudson Canal Company.	54	30
87	N. Y	1255	.....	Canandaigua, Elmira .....	Northern Central .....	68.5	23
88	N. Y	1224	.....	Troy, Albany Junction .....	Delaware and Hudson Canal Company.	6	30
89	Ga.	15004	15004	Augusta, Atlanta .....	Georgia .....	171.62	25

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
			112, 836	3, 961	19 by 7.3, 8 by 6.8, f. f., d. l.	59½	\$187 50	Part; residue \$150, (83.)	56
131, 814	37, 012	168, 826	162, 311	5, 410	r. p. o., 45 by 9.5, f. f., a. l.; apt. in b. c., (no r. a.), 14.9 by 9.7, f. f., a. l.	13	186 00		57
100, 392	61, 801	162, 193	114, 901	3, 830	r. p. o., 39.2 by 9.2, f. f. c., a. l.	15½	185 00		58
55, 112	55, 601	110, 703	66, 695	2, 223	r. p. o., 40 by 9.8, f. f. c., a. l.	18	185 00	In April, 1875.	59
125, 601	33, 307	158, 908	150, 924	5, 030	r. p. o., 45 by 9.5, f. f., a. l.; apt. in b. c., (no r. a.), 14.9 by 9.7, f. f., a. l.	13	183 00		60
22, 642	119, 126	141, 768	141, 768	4, 725	In charge of conductor.	12	182 00		61
57, 126	118, 725	175, 851	84, 851	2, 819	r. p. o., (average,) 34.9 by 9.7, f. f., a. l.	7	180 00		62
49, 040	50, 011	99, 051	58, 579	1, 952	r. p. o., 40 by 9.2, f. f. c., a. l.	18	178 00	In Mar., 1876. Weigh- ing voluntary.	63
35, 191	121, 533	156, 724	149, 075	4, 969	r. p. o., 45 by 9.5, f. f., a. l.	17½	175 00	Part; residue \$145, (93.)	64
17, 244	33, 150	50, 394	49, 848	1, 661	13 by 8.7, f. f., a. l.	13	175 00		65
101, 604	36, 779	138, 383	110, 992	3, 699	21.8 by 8.7, f. f., a. l.	13	172 00	Main route; branch \$50, (308.) 0.07 m. increase.	66
342, 669	163, 680	512, 349	426, 975	7, 116	r. p. o., 50.5 by 9.2, f. f., a. l.	20	166 00	60 days, from Dec. 1, 1875.	67
54, 534	29, 531	84, 065	72, 990	2, 433	18 by 9, f. f., a. l.	7	164 00	Part; residue \$75, (173)	68
33, 350	45, 595	83, 945	36, 211	1, 207	24 by 9, f. f., a. l.	14	160 00	Main route; branches \$50, \$30, (359, 435.)	69
10, 819	26, 342	37, 161	25, 420	847	14.6 by 9.6, f. f., a. l.	12	158 00		70
26, 566	79, 203	105, 769					153 00	82.08 m. at \$100. See parts, (72, 134.)	71
			93, 193	3, 106	22.7 by 8.9, f. f., a. l.	13	155 00	Part; residue \$100, (134.)	72
51, 467	84, 970	136, 437	62, 692	2, 069	14 by 7.3, f. f., a. l.	6	153 00	In March, 1875.	73
152, 276	241, 424	399, 700					152 00	60 days, from Dec. 15, 1875. See parts, (75, 80.)	74
			327, 781	5, 463	r. p. o., 50 by 8, f. f., a. l.	21	152 00	Part; residue \$152, (80.) 60 days, from Dec. 15, 1875. See whole route, (74.)	75
44, 277	71, 143	115, 420					152 00	In June, 1875. See parts, (78, 79.)	76
64, 292	65, 331	129, 613	80, 897	2, 696	13 by 9, f. f., a. l.	15½	152 00		77
			69, 641	2, 321	r. p. o., 50 by 8, f. f., a. l.	20	152 00	In June, 1875. Part; residue \$152, (79.) See whole route, (76.)	78
			25, 809	860	16.6 by 6.8, f. f., a. l.	18*	152 00	In June, 1875. Part; residue \$152, (78.) See whole route, (76.)	79
			30, 828	513	16.6 by 6.8, f. f., a. l.	18*	152 00	Part; residue \$152, (75.) 60 days, from Dec. 15, 1875. See whole route, (74.)	80
144, 355	62, 338	212, 693	168, 980	2, 816	21.9 by 7, f. f., a. l.	21½	150 00	60 days, in May and August, 1875.	81
36, 261	54, 264	90, 525	77, 951	2, 598	18 by 9, f. f., a. l.	14	150 00		82
			71, 751	2, 391	19 by 7.3, 8 by 6.8, f. f., a. l.	27*	150 00	Part; residue \$187.50, (56)	83
121, 020	78, 207	202, 236	134, 035	2, 233	21.9 by 7, f. f., a. l. to Castleton, 51 m.; d. l. residue, 11½ m.	20½	150 00	60 days, in May and August, 1875.	84
54, 946	36, 997	91, 943	52, 311	1, 743	8 by 6.8, 9 by 7.3, f. f., a. l.	16½	150 00		85
103, 592	48, 096	151, 688	92, 670	1, 644	21.9 by 7, f. f., a. l.	16½	150 00	60 days, in May and August, 1875.	86
24, 927	36, 390	61, 307	39, 965	1, 332	15 by 8.4, (average,) 1½ l.	18½	150 00	In November, 1875.	87
11, 149	7, 077	18, 266	16, 424	547	no r. a.	24	150 00	Branch; main route \$107, (116.)	88
41, 450	39, 916	80, 375	55, 660	1, 855	r. p. o., 25.4 by 8.8, f. f., a. l.	12	147 00	30 days, from May 15, 1876.	89

## REPORT OF THE POSTMASTER-GENERAL.

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
						<i>Miles.</i>	
90	Tenn.	19004	19004	Nashville, Chattanooga .....	Nashville and Chattanooga .....	153	.....
91	Tenn.	19004	19004	Nashville, Stevenson .....	do .....	114	25
92	Tenn.	19004	19004	Nashville, Chattanooga .....	do .....	153	25
93	Tenn.	19010	19010	Memphis, Milan .....	Louisville and Nashville .....	89	25
94	Ind.	22007	22007	New Albany, Indianapolis ..	Jeffersonville, Madison and Indianapolis.	114	27
95	N. Y.	1224	.....	Whitehall, Castleton .....	Delaware and Hudson Canal Company.	16	30
96	Ala.	17013	17013	Mobile, New Orleans .....	New Orleans, Mobile and Texas.	140	26
97	Va.	4407	13004	Danville, Greensborough .....	Richmond and Danville .....	42.3	.....
98	Ga.	15003	15003	Atlanta, West Point .....	Atlanta and West Point .....	86.68	22
99	Vt.	410	.....	Lunenburg Junction, Johnson.	Portland and Ogdensburg ..	78.81	20
100	Ga.	6001	15004	Augusta, Atlanta .....	Georgia .....	171.62	25
101	N. C.	13007	13007	Charlotte, Augusta .....	Charlotte, Columbia and Augusta.	195.75	20
102	S. C.	5607	14005	Charleston, Florence .....	Northeastern .....	103	19
103	Miss.	7004	18004	Mobile, Columbus .....	Mobile and Ohio .....	472.7	24
104	Ga.	15009	15009	Savannah, Live Oak .....	Atlantic and Gulf .....	179.20	20
105	Ohio.	9015	21013	Columbus, Delaware .....	Cleveland, Columbus, Cincinnati and Indianapolis.	24.75	30
106	Ohio.	9029	21025	Hamilton, Richmond .....	Cincinnati, Richmond and Chicago.	45.1	25
107	Ohio.	9005	21004	Hudson, Columbus .....	Cleveland, Mount Vernon and Delaware.	145.88	.....
108	S. C.	14005	14005	Charleston, Florence .....	Northeastern .....	103	15.5
109	Tenn.	19008	19008	Nashville, Guthrie .....	Saint Louis and Southeastern.	48	23
110	S. C.	14004	14004	Charleston, Savannah .....	Savannah and Charleston ..	107.63	17
111	Ga.	15012	15012	Macon, Atlanta .....	Central Railroad and Banking Company.	103.52	20
112	Ill.	23032	.....	Saint Louis, Evansville .....	Saint Louis and Southeastern.	164.75	23
113	Ky.	20002	20002	Covington, Nicholasville .....	Kentucky Central .....	112	.....
114	Ky.	20002	20002	Covington, Lexington .....	do .....	99	22
115	Ky.	20010	20010	Evansville, Guthrie .....	Saint Louis and Southeastern.	110.66	23
116	N. Y.	1224	.....	Albany, Canada Line .....	Delaware and Hudson Canal Company.	129.93	30
117	Ala.	17001	17001	Montgomery, West Point .....	Western, of Alabama .....	88.5	23
118	Md.	3514	.....	Baltimore, Washington .....	Baltimore and Potomac .....	42.6	26
119	Md.	3514	.....	do .....	do .....	42.6	.....
120	Tenn.	19002	19002	Cleveland, Dalton .....	East Tennessee, Virginia and Georgia.	28.5	20
121	Ohio.	9003	21003	Pittsburgh, Bellaire .....	Cleveland and Pittsburgh .....	94.5	30

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
28,742	67,226	136,568					\$145 00	39 m. at \$205. With lap service. See parts, (46, 91.)	90
			79,546	2,651	12.6 by 8.8, f. f., a. l.	153*	145 00	Part; residue (46.) See whole route, (90.)	91
71,761	35,740	107,501	76,033	2,534	12 6 by 8 8, f. f., a. l.	153*	145 00	39 m. at \$205. With-out lap service.	92
21,934	62,836	87,772	72,481	2,416	15 by 8, f. f., a. l.	20	145 00	Part; residue (64.)	93
34,131	48,404	82,535	58,443	1,948	13 by 7, f. f., a. l.	19	134 00		94
35,005	4,660	39,665	37,674	1,255	r. a. in b. c., a. l.	6	132 00	Branch; main route \$107, (116.)	95
39,563	33,812	73,377	64,468	2,148	17.6 by 7.3, f. f., a. l.	14	130 00		96
56,976	23,770	80,752	77,488	2,582			125 00	Part of route 13004. Weighing voluntary.	97
45,360	31,664	80,024	72,132	2,404	17 by 8.3, f. f., a. l.	14	125 00	In Jan., 1876. 0.39 m. increase.	98
47,778	43,740	91,518	67,964	2,265	20 by 6.6, 15 by 6.6, f. f., a. l.	64*	125 00	In March, 1876.	99
41,347	41,269	82,656	58,292	1,943	24.6 by 8.6, f. f., a. l.	13	125 00	In Oct., 1875. .04 m. decrease.	100
45,900	24,982	70,882	40,899	1,363	19 by 8, fixtures, a. l.	103*	125 00	1.25 m. decrease.	101
12,305	32,541	44,846	39,784	1,320	11 by 8.4, f. f., a. l.	13	125 00	In October, 1875. 1 m. decrease.	102
38,540	49,041	87,581	19,785	659	22 by 9, f. f., a. l.	7	125 00	In Oct., 1875. Main route; branch \$50, (208.)	103
47,265	20,430	67,695	51,056	1,701	16.8 by 9.3, f. f., a. l.	13	120 00	Main route; branch \$52, (217.) 1.27 m. decrease.	104
19,487	26,942	46,429	43,606	1,453	11 by 9.2, f. f., a. l.	6	120 00		105
21,182	10,297	31,479	26,616	887	12 by 9, f. f., a. l.	12	118 00		106
27,150	28,029	55,179	21,621	720			117 00		107
23,104	53,700	76,804	70,983	2,366	12 by 9, f. f., a. l.	13	116 00		108
14,747	7,127	21,874	17,697	589	11.6 by 7.6, f. f., a. l.	13	112 00		109
45,422	19,649	65,071	54,022	1,800	9 by 9, f. f., a. l.	13	111 00	3.63 m. increase	110
22,752	26,481	49,233	37,360	957	17.7 by 6.7, f. f., a. l.	13	110 00	39 days, 9 from March 15 and 30 from May 15, 1876.	111
22,798	18,770	41,568	20,832	694	12 by 6.6, f. f., a. l.	12	110 00	Main route; branch \$50, (362.) In March, 1875; reported Oct., 1875.	112
41,559	22,057	63,616					109 00	13 m. at \$75. See parts, (114, 175.)	113
			42,794	1,426	12 by 6.6, fixtures, a. l.	12	109 00	Part; residue (175.) See whole route, (113.)	114
12,774	18,896	31,600	15,347	511	11.6 by 7.6, f. f., a. l.	13	108 00		115
102,045	48,515	157,560	63,714	2,123	21.6 by 6.9, f. f., a. l.	171*	107 00	Main route; branches \$150, \$132, (88, 95.)	116
33,252	46,908	80,160	66,140	2,204	18 by 8.6, f. f., a. l.	14	105 00	In January, 1876.	117
			12,772		r. p. o., 46.10 by 9, f. f., a. l.; r. a. apt., 14.6 by 8.6, f. f., a. l.	13	100 00	Daily average of returns for Oct., 1873, and night r. p. o. l. for 90 days from October 1, 1875.	118
476,312	543,617	1019929	1019929	11,332	r. p. o., 46.10 by 9, f. f., a. l.	6	103 00	90 days, from October 1, 1875, on night r. p. o. l.	119
47,370	21,450	61,820	60,529	2,017	22 by 8.4, f. f., a. l.	14	100 00	Branch; main route \$244, (32.)	120
180,663	63,170	189,835	51,510	1,717	13 by 9, f. f., a. l.	13	100 00	25.75 m. increase by extension to commence at Pittsburgh instead of Rochester.	121

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
122	N. J.	2106	7013	New York, Washington	Morris and Essex	Miles. 73	25
123	Ohio	9006	21005	Cleveland, Sharpsville	Atlantic and Great Western	84.40	25
124	Ga.	6008	15009	Savannah, Live Oak	Atlantic and Gulf	180.47	19
125	N. J.	2106	7013	New York, Easton	Morris and Essex	87.40	
126	Ga.	6011	15012	Macon, Atlanta	Macon and Western	103.52	20
127	Ind.	22012	22012	Evansville, Terre Haute	Evansville and Crawfordville	110	22
128	Mo.	22030		Saint Joseph, Atchison	Hannibal and Saint Joseph	22.08	20
129	Ohio	9006	21005	Cleveland, Leavittsburgh	Atlantic and Great Western	49.75	25
130	Tex.	31004		Hempstead, Austin	Houston and Texas Central	119.7	20
131	Ga.	15001	15001	Atlanta, Charlotte	Atlanta and Richmond Air Line	266.50	24
132	N. Y.	1245		Albany, Binghamton	Delaware and Hudson Canal Company	142	30
133	Miss.	18003	18003	Vicksburgh, Jackson	Vicksburgh and Meridian	45.5	18
134	S. C.	14002	14002	Columbia, Florence	Wilmington, Columbia and Augusta	82.08	25
135	Wis.	25014		Elroy, Saint Paul	West Wisconsin	198.4	23
136	Ohio	9013	21012	Springfield, Sandusky	Cincinnati, Sandusky and Cleveland	131.35	30
137	N. J.	2111	7019	Glassborough, Millville	West Jersey	22	21
138	Ind.	22004	22004	Indianapolis, Peru	Indianapolis, Peru & Chicago	78	21
139	Ala.	6610	17010	Selma, Dalton	Selma, Rome and Dalton	237.5	20
140	Ga.	15011	15011	Macon, Columbus	Southwestern	100.94	20
141	Ill.	11913	23036	Aurora, Foreston	Chicago and Iowa	81.64	21
142	Ohio	9012	21011	Xenia, Dayton	Pittsburgh, Cincinnati and Saint Louis	17	25
143	Ky.	20003	20003	La Grange, Lexington	Louisville, Cincinnati and Lexington	67	20
144	Ohio	9038	21034	Salamanca, Dayton	Atlantic and Great Western	389.55	27
145	Ohio	9022		Bluffs, Naples	Toledo, Wabash and Western	4	
146	Fla.	16002	16002	Jacksonville, Chattahoochee River	Jacksonville, Pensacola and Mobile	213.52	18
147	Me.	244		Bangor, Bucksport	Consolidated European and North American Railway	19.35	22
148	Tenn.	19006	19006	Nashville, Decatur	Louisville and Nashville	192½	24
149	N. J.	2103	7004	Frankfort Junction, Kensington Station	Pennsylvania	2.95	27½
150	Ohio	9013	21012	Springfield, Sandusky	Cincinnati, Sandusky and Cleveland	131.35	
151	Ohio	9040	21036	Columbus, Athens	Columbus & Hocking Valley	77.40	23
152	Mich.	21035		Toledo, Detroit	Toledo, Canada Southern and Detroit	56.37	28
153	N. Y.	1224		Albany, Albany Junction	Delaware and Hudson Canal Company	12	30
154	Ark.	22005		Argenta, Altus	Little Rock and Fort Smith	120	12
155	Miss.	18004	18004	Mobile, Columbus	Mobile and Ohio	472.7	19

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
			49, 101	1, 636	12 by 7.3, (63 m.) 11.7 by 7.7, (73 m.) 19.9 by 7.6, (29 m.) f. f., d. l. to Dover, 44 m., t. l. thence to Hackettstown, 19 m., d. l. residue, 10 m.	131*	\$100 00	In July, 1874; reported Nov., 1875, 10 m. at \$50. Part; residue \$50, (263.)	122
20, 331	17, 915	47, 246	.....	.....	14.4 by 7.10, f. f., s. l.	.....	100 00	31.61 m. at \$50; 3 04 m., at \$68. See parts, (129, 252.)	123
21, 533	47, 767	125, 300	91, 180	1, 519	16.8 by 9.3, f. f., s. l.	7	100 00	60 days, in Jan. and Oct., 1875. 0.28 m. decrease. Main route; branch \$50, (268.)	124
71, 611	41, 907	113, 520	42, 650	1, 421	.....	.....	100 00	24.40 m. at \$50. See parts, (122, 264.)	125
17, 900	28, 507	46, 467	37, 076	1, 235	11.7 by 6.7, f. f., s. l.	13	100 00	In November, 1875	126
21, 655	37, 341	58, 716	35, 661	1, 184	12.6 by 8. f. f., s. l.	12	100 00	.....	127
24, 205	8, 561	33, 477	33, 477	1, 115	13 by 7, f. f., s. l.	13	100 00	In May and June, 1876	128
.....	.....	.....	33, 241	1, 108	14.4 by 7.10, f. f., s. l.	24	100 00	Part; residue \$50, \$68, (123, 252.) See whole route, (123.)	129
24, 973	14, 092	43, 065	32, 840	1, 094	14 by 7.3, f. f., s. l.	6	100 00	In March, 1875	130
24, 951	28, 173	53, 124	31, 374	1, 045	19.11 by 8.11, f. f., s. l.	7	100 00	.....	131
28, 076	64, 116	150, 192	61, 977	1, 032	17.4 by 9.10, f. f., s. l.	107	100 00	60 days, in May and August, 1875.	132
.....	.....	.....	30, 684	1, 022	12 by 7.2, f. f., s. l.	7	100 00	Part; residue \$59, (209)	133
.....	.....	.....	26, 095	869	22.7 by 8.9, f. f., s. l.	7	100 00	Part; residue \$155, (72)	134
40, 340	20, 516	50, 896	23, 064	768	40 by 9, f. f., s. l.	6	100 00	In Sept., 1875. Main route; branch \$30.	135
28, 643	24, 558	53, 291	22, 544	751	13.6 by 9, f. f., s. l. and m. c.	13	100 00	In April, 1875	136
15, 671	10, 793	26, 464	21, 738	724	13 by 8.3, f. f., s. l.	12	100 00	In March, 1876	137
19, 214	16, 871	36, 105	30, 989	679	12 by 7.1, f. f., s. l.	20*	100 00	.....	138
16, 563	23, 915	40, 478	16, 362	543	14 by 7.6, f. f., s. l.	7	100 00	In October, 1875	139
37, 468	22, 249	59, 717	23, 275	517	12.8 by 6.3, f. f., s. l.	6	100 00	45 days, 15 from Mar. 15 and 30 from May 15, 1876.	140
53, 935	23, 884	77, 819	58, 371	972	38 by 9, f. f. c., s. l.	12	98 00	60 days, in March, 1875, and January, 1876.	141
5, 362	6, 255	11, 617	11, 157	371	14 by 8.7, f. f., s. l.	18	94 00	.....	142
29, 604	19, 331	39, 988	24, 673	822	8.6 by 6.1, f. f., s. l.	12	92 00	.....	143
22, 744	76, 598	165, 342	29, 085	969	14.4 by 7.10, f. f., s. l.	16*	80 00	.....	144
15, 206	6, 681	21, 881	21, 881	729	.....	.....	90 00	In March, 1876, by Department.	145
47, 080	66, 831	113, 911	36, 988	616	16 by 8, (22 m.) 10 by 7, (133.75 m.) f. f., s. l.	11½*	90 00	60 days, half from Nov. 15, 1875, and residue from Jan. 1, 1875. Main route; branch \$30, (442.)	146
12, 274	7, 971	20, 245	17, 390	582	9.6 by 7.6, f. f., d. l.	12	89 00	In September, 1875	147
55, 794	19, 584	85, 378	50, 122	1, 670	14.9 by 9, f. f.	9½*	88 00	Average speed	148
11, 550	46, 041	57, 591	57, 591	964	13 by 6.2½, s. l.	18	88 00	60 days, from Dec. 1, 1875. Branch; main route \$628, (3.)	149
24, 187	23, 194	47, 381	18, 480	616	.....	.....	87 50	.....	150
18, 315	11, 194	27, 509	13, 157	438	16 by 8.6, f. f., s. l.	12	87 50	Main route; branch \$40 (415.)	151
14, 204	20, 680	34, 893	25, 772	859	16 by 9.3, 10.9 by 9.3, f. f., s. l. 39.07 m., to Trenton Crossing, d. l. residue, 17.30 m.	14½*	86 00	.....	152
45, 598	31, 121	76, 719	68, 887	1, 148	no r. a.	18	85 73	60 days, in May and August, 1875.	153
26, 571	13, 160	39, 731	26, 994	899	11 by 6, f. f., s. l.	6	85 00	In January, 1876	154
42, 512	52, 668	95, 180	22, 569	752	21.6 by 8.6, f. f., s. l.	7	82 00	Main route; branch \$50, (292.)	155

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
						<i>Miles.</i>	
156	Ohio...	9019	21017	Blanchester, Hillsborough	Marietta and Cincinnati	21	25
157	Pa. ....	2145	2045	Miles Grove, New Castle	Erie and Pittsburgh	83	20
158							
159	Iowa ...	27011		Viele Junction, Burlington	Chicago, Burlington & Quincy	25.75	21
160	Ga. ....	15010	15010	Savannah, Macon	Central Railroad and Banking Company	192½	20
161	Iowa ...	27011		Kooknk, Viele Junction	Chicago, Burlington & Quincy	17	21
162	S. C. ....	14003	14003	Branchville, Charleston	South Carolina	62.25	18
163	Miss. ....	7002	18002	Memphis, Grenada	Mississippi and Tennessee	101.7	20
164	Ga. ....	15005	15005	Millen, Augusta	Central Railroad and Banking Company	53½	15
165	Tenn. ....	19007	19007	Nashville, Hickman	Nashville and Chattanooga	170.82	20
166	Ind. ....	22013	22014	State Line, Logansport	Pittsburgh, Cincinnati and Saint Louis	61	22
167	Kans. ....	33013		Topeka, Kansas City	Atchison, Topeka and Santa Fe	49.84	22
168	Ind. ....	22009	22009	Richmond, Chicago	Pittsburgh, Cincinnati and Saint Louis	225.5	25
169	Tex. ....	31005		Bremond, Waco	Houston and Texas Central	44.56	20
170	Ala. ....	17004	17004	Montgomery, Decatur	South and North Alabama	182.85	25
171	Ala. ....	17010	17010	Selma, Dalton	Selma, Rome and Dalton	237.5	20
172	N. Y. ....	1208		Carthage, Theresa Junction	Utica and Black River	20.5	21
173	N. C. ....	13004	13004	Goldsborough, Greensborough	Richmond and Danville	130.35	21
174	Md. ....	3507	10006	Baltimore, Williamsport	Western Maryland	91.62	25
175	Ky. ....	20002	20002	Lexington, Nicholasville	Kentucky Central	13	22
176	N. C. ....	13001	13001	Raleigh, Weldon	Raleigh and Gaston	97	20
177	Ga. ....	6006	15007	Union Point, Athens	Georgia	39.92	25
178	Ohio ...	9033	21029	Morrow, Dresden	Pittsburgh, Cincinnati and Saint Louis	149.4	24
179	N. J. ....	2112	7020	Millville, Cape May	West Jersey	41	32
180	Ill. ....	23038		Peoria, Jacksonville	Peoria, Pekin and Jacksonville	87.40	19
181	Va. ....	4415	11015	Portsmouth, Weldon	Seaboard and Roanoke	79.26	30
182	S. C. ....	5602	14001	Columbia, Greenville	Greenville and Columbia	144.01	15
183	Md. ....	3513	10012	Clayton, Chestertown	Kent County	30.80	16
184	Miss. ....	18006	18006	Grand Gulf, Port Gibson	Grand Gulf and Fort Gibson	8	18
185	Ohio ...	9042	21038	Newark, Shawnee	Newark, Somerset and Straitsville	44.045	27
186	Nev. ....	45001		Reno, Virginia City	Virginia and Truckee	51.75	16
187	N. Y. ....	1804		Saratoga Springs, North Creek	Adirondack	57.96	20
187	Ga. ....	15016	15016	Macon, Eufaula	Southwestern	144.84	17½
188	S. C. ....	14003	14003	Kingsville, Augusta	South Carolina	118	17
189	S. C. ....	14003	14003	Kingsville, Columbia	do	25.70	18
190	N. J. ....	2258	7003	Elizabethport, Sea Plain	Central, of New Jersey	47.9	27
191	Miss. ....	18002	18002	Memphis, Grenada	Mississippi and Tennessee	101.7	20
192	Ga. ....	15013	15013	Macon, Brunswick	Macon and Brunswick	188	18



are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
5,448	2,732	8,220	6,493	216	b. c., no r. a.	12	\$1 00		156
22,112	42,355	76,467	48,190	1,606	12 by 9, f. f., a. l.	12	80 00	In August, 1875	157
								Vacant	158
			22,145	738	15.3 by 8.9, f. f., a. l.	12	80 00	Part; with lap. Lap 6 trips, (161.)	159
25,104	22,475	47,579	22,697	597	8.2 by 7, f. f., a. l.	14	80 00	38 days, 8 from March 15 and 30 from May 15, 1876.	160
			17,213	574	15.3 by 8.9, f. f., a. l.	12	80 00	Part; residue lap, (159)	161
11,931	6,986	18,917	16,914	563	10 by 8, f. f., a. l.	20	80 00	Branch; main route \$70, (188.) 1.25 m. decrease.	162
9,322	11,492	20,814	11,535	394	12.3 by 6.10, f. f., a. l.	10*	80 00	In October, 1875	163
11,973	12,195	24,168	20,737	518	8.2 by 7, f. f., a. l.	14	79 00	40 days, 10 from March 15 and 30 from May 15, 1876.	164
19,969	19,674	39,643	22,010	733	12.6 by 8.8, f. f., a. l.	12*	78 00		165
10,621	19,096	29,717	21,324	710	18.4 by 8.7, f. f., a. l.	6	75 00		166
7,827	17,100	24,927	21,261	708	13 by 8.6, (average,) f. f., a. l.	7	75 00	In January, 1876	167
28,620	22,257	42,947	19,846	661	11 by 8.9, f. f., a. l.	13	75 00		168
11,911	8,314	20,225	19,028	634	14 by 7.3, f. f., a. l.	6	75 00	In March, 1875	169
25,773	39,207	64,980	18,332	611	14 by 7.6, a. l.	7	75 00	63.8 miles at \$117.50.	170
28,602	40,752	69,354	29,553	546	15 by 7.8, f. f., a. l.	7	75 00	54 days, 24 from March 15 and 30 from May 15, 1876.	171
			15,270	529	9 by 9, f. f., a. l.	12	75 00	Part. In March, 1876.	172
15,031	14,586	32,617	15,748	524	19 by 8, f. f., a. l.	7	75 00	Part; residue \$164, (68.)	173
21,622	11,826	33,448	15,298	509	10.6 by 8, f. f., a. l.	12	75 00	In March, 1876. 6.12 miles at \$40.	174
			12,711	423	12 by 6.6, fixtures, a. l.	6	75 00	Part; residue \$109, (114.) See whole route, (113.)	175
8,531	12,590	21,121	12,104	408	12 by 9, f. f., a. l.	6	75 00		176
7,274	7,421	14,695	11,276	375	24.6 by 8.6, f. f., a. l.	13	75 00	In October, 1875	177
20,600	16,832	37,432	10,753	358	14.6 by 6.10 f. f., a. l.	6*	75 00		178
7,647	5,675	13,322	9,804	326	13 by 8.3, f. f., a. l.	12	75 00	In March, 1876	179
10,504	9,870	20,384	9,686	322	13.4 by 8, f. f., a. l.	6*	75 00	In Mar., 1875. (See F.)	180
10,222	9,330	20,152	9,367	312	20.6 by 8.6, f. f. c. and m. c.	6*	75 00	In October, 1875. 0.74 m. decrease.	181
13,138	8,685	21,823	9,141	304	12 by 7, f. f., a. l.	6	75 00	In October, 1875 Main route; branches \$30, (483, 434.)	182
6,344	4,642	10,986	8,417	280	16 by 6, f. f., a. l.	6	75 00	In July, 1876. \$75 on 19.55 miles.	183
1,424	790	2,214	2,214	73	In charge train-men	6	75 00		184
3,903	2,464	6,367	1,911	63	14 by 9, f. f., a. l.	8*	75 00		185
16,842	9,880	26,722	23,597	786	13.10 by 8, a. l.	7	72 29	In March, 1876	186
14,409	9,454	22,863	17,349	578	13.6 by 5.10, f. f., a. l.	6	72 00		186
25,826	15,221	42,117	21,392	475	12.8 by 6.3, f. f., a. l.	6	70 00	45 days, 15 from March 15 and 30 from May 15, 1876. Main route; branches \$50, \$40, \$35, (278, 410, 429.)	187
14,451	19,727	34,178	13,942	464	10 by 8, f. f., a. l.	13	70 00	Main route; branches \$80, \$70, \$50, (162, 189, 352.)	188
8,429	5,734	14,163	13,548	451	10 by 8, f. f., a. l.	13	70 00	Branch; main route \$70, (188.)	189
13,138	7,142	20,280	12,660	422	12 by 7, fixtures, a. l.	12	68 00		190
11,363	12,463	23,826	14,381	479	13.2 by 6.10, f. f., a. l.	10*	65 00		191
16,661	11,017	27,678	20,240	439	14 by 7, f. f., a. l.	6	65 00	46 days, 16 from March 15 and 30 from May 15, 1876; 7 trips part of the year. Main route; branch \$40, (419.)	192

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
193	Ohio ..	9034	21030	Dayton, Richmond.....	Pittsburgh, Cincinnati and Saint Louis.	<i>Miles.</i> 42	25
194	Ky ...	20011	20011	Louisville, Elizabethtown, Paducah.	Louisville, Paducah and South-western.	232.19	30
195	Ill ....	23005	.....	Sterling, East Saint Louis...	Saint Louis, Rock Island and Chicago.	291.36	22
196	Ga ....	15007	15007	Union Point, Athens.....	Georgia .....	39.92	20
197	Ala....	17007	17007	Opelika, Columbus.....	Western, of Alabama.....	28	15
198	N. Y. ..	1290	.....	Buffalo, Jamestown .....	Buffalo and Jamestown .....	71.09	25
199	Utah ..	41002	.....	Salt Lake City, Provo City...	Utah Southern .....	49	15
200	Ohio ..	9035	21031	North Bend, Hagerstown...	White Water Valley.....	72.58	25
201	Ga....	15018	15018	Thomasville, Albany.....	Atlantic and Gulf.....	52.91	17.5
202	N. J. ...	2113	7021	Elmer, Salem .....	West Jersey .....	16.60	23.13
203	Kans ..	33009	.....	Atchison, Lincoln.....	Atchison and Nebraska.....	152.28	23
204	Ohio ..	9047	21043	Mansfield, Toledo.....	Pennsylvania Company.....	88.10	22
205	Col ....	39005	.....	Kit Carson, West Las Animas	Arkansas Valley.....	56	20
206	Cal ....	46017	.....	Los Angeles, Anaheim.....	Southern Pacific .....	21.7	20
207	Ohio ..	9026	21022	Dayton, Union City.....	Dayton and Union .....	42.17	20
208	Miss ..	7004	18004	Artesia, Columbus.....	Mobile and Ohio .....	14	9
209	Miss ..	18003	18003	Vicksburgh, Meridian .....	Vicksburgh and Meridian.....	140.7	18
210	Ky ....	20016	20016	Mayaville, Paris .....	Mayaville and Lexington.....	50	19½
211	Miss ..	18003	18003	Jackson, Meridian .....	Vicksburgh and Meridian.....	93.2	18
212	Kans ..	33006	.....	Junction City, Parsons.....	Missouri, Kansas and Texas...	156.5	16
213	S. C. ...	14001	14001	Columbia, Greenville.....	Greenville and Columbia.....	144.01	16
214	Ind ...	22019	22020	Fort Wayne, Connersville...	Fort Wayne, Muncie and Cincinnati.	109	22
215	R. I. ...	825	.....	Wickford Landing, Wickford Junction.	Newport and Wickford Railroad and Steamboat Co.	3.40	30
216	Mo ....	28016	.....	Pleasant Hill, Carbondale...	Saint Louis, Lawrence and Western.	94	20
217	Ga....	15009	15009	Dupont, Bainbridge.....	Atlantic and Gulf.....	106.37	18
218	N. Y. ...	1228	.....	Carthage, Morristown.....	Utica and Black River .....	50.08	20
219	N. Y. ...	1228	.....	Carthage, Clayton.....	.....do .....	36½	20
220	N. C. ...	13006	13006	Salisbury, Henry's.....	Western North Carolina .....	117.31	13
221	N. Y. ...	1296	.....	New York, Patchogue .....	Flushing, North Side and Central.	59.21	25.5
222	N. Y. ...	1228	.....	Theresa Junction, Morristown.	Utica and Black River.....	29.58	20
223	Mich ..	24008	.....	Fort Wayne, Jackson.....	Fort Wayne, Jackson and Saginaw.	96.82	22
224	Ala....	17009	17009	Selma, Meridian .....	Alabama Central.....	102.2	16½
225	Ind ...	22014	22015	Peru, La Porte.....	Chicago, Cincinnati and Louisville.	73	21
226	N. C. ...	13005	13005	Goldsborough, Morehead City.	Atlantic and North Carolina..	94.04	20
227	N. C. ...	13003	13003	Wilmington, Charlotte.....	Carolina Central.....	193.80	17½
228	Ky ....	20007	20007	Lebanon Junction, Fish Point.	Louisville and Nashville.....	109.9	.....
229	Ky ....	20007	20007	Lebanon Junction, Richmond Junction.	.....do .....	76.4	20
230	Ga....	15021	15021	Camak, Macon.....	Macon and Augusta .....	80.66	25

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
6,712	4,015	10,727	8,599	286	14 by 8.7, f. f., a. l.	12	\$65 00		193
29,723	12,298	42,021	19,240	641	10.3 by 8, (average,) a. l.	6	64 00		194
32,504	33,942	66,446	13,522	450	12 by 9.4, f. f., a. l.	13½*	64 00		195
7,028	7,380	14,408	11,218	373	9 by 6.8, f. f., a. l.	6	64 00		196
12,102	10,456	22,558	20,445	444	18 by 8.6, f. f., a. l.	14	63 00	46 days, 16 from March 15 and 30 from May 15, 1876.	197
14,539	8,679	23,218	10,962	365	18 by 7, f. f., a. l.	6½*	63 00	In March, 1876.	198
2,442	5,271	13,713	10,851	361	15 by 8.9, f. f., a. l.	7	63 00	In July, 1875.	199
10,951	14,996	25,947	13,331	444	12 by 7.8, f. f., a. l.	6	62 50		200
3,200	3,346	6,546	4,223	140	12 by 6, f. f., a. l.	7	62 00		201
4,184	2,791	6,975	5,662	188	10.7 by 6.6, No r. a.	12	60 24	In March, 1876.	202
16,909	15,851	32,760	16,763	558	18.2 by 8.10, 12 by 7, f. f. c., a. l.	6	60 00	In June, 1876.	203
13,119	12,954	26,123	14,782	492	10 by 6.8, fixtures, a. l.	12	60 00		204
9,552	3,242	13,394	13,394	446	in b. c. No r. a.	7	60 00	In September, 1875.	205
2,334	4,082	12,422	11,210	373	no r. a.	7	60 00	In August, 1876.	206
2,795	6,166	14,961	7,811	260	11 by 7.4, f. f., a. l.	12	60 00		207
3,339	1,797	5,136	5,136	171	in b. c. No r. a.	14	60 00	In October, 1875.	208
16,275	32,404	48,679			12 by 7.2, f. f., a. l.	7	59 00	Branch; main route \$125, (103.) 45.5 miles at \$100. See parts, (133, 211.)	209
6,296	12,149	18,445	12,493	416	10 by 7.6, f. f., a. l.	6	59 00		210
			11,388	379	12 by 7.2, f. f., a. l.	7	59 00	Part; residue \$100, (133.)	211
13,027	14,690	27,717	15,278	509	11 by 7, f. f., a. l.	7	58 00	In July, 1875. Weighing voluntary.	212
12,562	11,979	24,541	10,466	348	12 by 8, f. f., a. l.	6	58 00	Main route; branches \$50, (302, 347.)	213
11,577	15,018	26,595	9,261	308	12 by 7.8, f. f., a. l.	6	58 00		214
2,938	6,495	9,433	9,052	301	no apt. No r. a.	15½*	58 00	In October, 1875.	215
13,465	5,051	18,516	8,976	299	13 by 6.1½, f. f., a. l.	6	58 00	In June, 1876.	216
6,701	4,157	10,858	4,807	160	12 by 7, (average,) f. f., a. l.	7	58 00	Branch; main route \$120, (104.)	217
11,167	7,842	18,949	10,834	361	9 by 9, f. f., a. l.	9*	57 00	Branch; main route \$37, (219.) 20.50 m. at \$75.	218
13,802	9,193	22,995	10,221	340	9 by 9, f. f., a. l., 18 m. In charge of baggage-master residue, 16 m.	12	57 00	Main route; branches \$57, \$75, (172, 222.)	219
13,849	5,290	19,139	9,207	306	10.3 by 8.3, 3.6 by 3.6, f. f., a. l.	6	57 00	Weight to Old Fort, 3 miles less.	220
15,509	12,239	27,728	8,736	291	12 by 6, f. f., a. l.	12	57 00	Main route; branch \$50, (309.) In Aug., 1875.	221
8,246	5,366	13,612	8,578	285	9 by 9, f. f., a. l.	12	57 00	Branch; main route \$57, (219.) In Mar., 1876.	222
9,429	9,911	19,340	6,601	220	10.4 by 7.2, f. f., a. l.	6	57 00	In April, 1875.	223
22,889	17,371	40,260	18,518	411	12.4 by 7.2, 12 by 7, f. f., a. l.	7	56 00	45 days, 15 from Mar. 15 and 30 from May 15 1876. Average speed.	224
8,233	9,913	18,746	10,090	336	12 by 7.1, f. f., a. l.	12	55 00		225
10,098	5,493	15,591	9,375	312	10.3 by 7.2, fixtures, a. l.	6	55 00		226
14,822	10,756	25,638	8,073	269	14 by 8.11, f. f., a. l.	13	55 00	In December, 1875.	227
26,794	14,451	41,245					54 00	Whole route; see parts, (229, 234.)	228
			22,264	742	14 by 7.4, f. f., a. l.	6	54 00	Main route, part; residue \$54, (234.) Branch \$50, (260.) See whole route, (228.)	229
15,425	9,996	25,421	15,422	328	11 by 6.7, f. f., a. l.	6	54 00	47 days, 17 from March 15 and 30 from May 15, 1876.	230

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
231	Ind...	22023	22024	Terre Haute, Danville.....	Evansville, Terre Haute and Chicago.	Miles. 56.6	22
232	N. Y...	1806	.....	Manorville, Sag Harbor.....	Long Island.....	35.25	24
233	Ala...	17002	17002	Montgomery, Selma.....	Western, of Alabama.....	50	23
234	Ky...	20007	20007	Richmond Junction, Fish Point.	Louisville and Nashville.....	33.5	13
235	N. C...	13010	13010	Raleigh, Cameron.....	Raleigh and Augusta Air Line	58.78	20
236	S. C...	14006	14006	Florence, Cheraw.....	Cheraw and Darlington.....	40.88	13½
237	Ohio...	9039	21035	Youngstown, Cross Cut.....	Pittsburgh, Fort Wayne and Chicago.	22.8	22
238	Del...	3403	9503	Clayton, Easton.....	Maryland and Delaware.....	44	25
239	Ohio...	9037	21033	Springfield, Columbus.....	Cincinnati, Sandusky and Cleveland.	45.86	.....
240	Ind...	22036	22027	Butler, Logansport.....	Detroit, Eel River and Illinois	94.5	25
241	Utah...	41002	.....	Provo City, York.....	Utah Southern.....	27	15
242	N. Y...	1811	.....	Rochester, Charlotte.....	New York Central and Hudson River.	9	25
243	Mich...	24008	.....	Jackson, Fort Wayne.....	Fort Wayne, Jackson and Saginaw.	96.82	20
244	Ky...	20013	20013	Anchorage, Shelbyville.....	Louisville, Cincinnati and Lexington.	19	18
245	Pa...	2429	8029	New Castle, Homewood.....	Pittsburgh, Fort Wayne and Chicago.	15	23
246	N. J...	2122	7028	New York, Denville.....	Delaware, Lackawanna and Western.	35.93	26½
247	Utah...	41003	.....	Ogden, Franklin.....	Utah Northern.....	79.94	14
248	Cal...	46011	.....	San Francisco, Cloverdale.....	San Francisco and North Pacific.	90	25
249	Ohio...	9045	21041	Lorain, Uhricksville.....	Cleveland, Tuscarawas Valley and Wheeling, (late Lake Shore and Tuscarawas Valley.)	102.45	25
250	Ind...	22008	22008	New Albany, Michigan City	Louisville, New Albany and Chicago.	288	20
251	Ohio...	9053	21049	Marietta, Parkersburgh.....	Marietta and Cincinnati.....	15.87	25
252	Ohio...	9006	21005	Leavittsburgh, Sharpville.....	Atlantic and Great Western.....	34.65	25
253	Ind...	22010	22021	Richmond, Fort Wayne.....	Grand Rapids and Indiana.....	91.50	24
254	Ga....	6012	15013	Macon, Brunswick.....	Macon and Brunswick.....	188	24
255	Ind...	22001	22001	Indianapolis, Vincennes.....	Indianapolis and Vincennes.....	116.32	23
256	Ohio...	9028	21024	Hamilton, Indianapolis.....	Cincinnati, Hamilton and Indianapolis.	99.49	24.5
257	N. Y...	1284	.....	Cayuga, Ithaca.....	Cayuga.....	34.05	25
258	Ga....	6016	15018	Thomasville, Albany.....	Atlantic and Gulf.....	60.79	17.5
259	Ind...	22006	22006	Columbus, Madison.....	Jeffersonville, Madison and Indianapolis.	46	20
260	Ky...	20007	20007	Richmond Junction, Richmond.	Louisville and Nashville.....	33.8	20
261	Ind...	22020	22021	Richmond, Fort Wayne.....	Grand Rapids and Indiana.....	91.5	23
262	Fla...	16003	16003	Pensacola, Whiting Junction	Pensacola and Louisville.....	44.05	13
263	N. J...	2106	7013	Washington, Easton.....	Morris and Essex.....	14.40	25
264	Ohio...	9009	21008	Bayard, New Philadelphia.....	Cleveland and Pittsburgh.....	32.5	15
265	N. Y...	1234	.....	Hicksville, Port Jefferson.....	Long Island.....	36.5	23
266	Ind...	22016	22017	Bradford, Logansport.....	Pittsburgh, Cincinnati and Saint Louis.	114.6	23

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
7,772	8,076	15,848	9,777	325	9.6 by 6.6, f. f., s. l.	13	\$54 00		231
7,459	4,506	11,965	7,531	250	10.8 by 9, f. fixtures, s. l.	6	54 00	In March, 1876	232
7,212	4,386	12,698	10,190	205	18 by 8.6, f. f., s. l.	7	54 00	45 days, 15 from March 15 and 30 from May 15, 1876.	233
-----	-----	-----	2,962	98	b. c.	6	54 00	Main route. Part; residue \$54, (229.) branch \$50, (260.) See whole route, (228.)	234
5,814	2,624	8,438	6,173	205	11.2 by 9, f. f., s. l.	6	53 00	Weight to Sanford. 45.78 miles; 13 miles at \$50.	235
5,221	3,642	8,863	5,221	194	13 by 9.9, f. f., s. l.	6	53 00		236
3,221	4,222	8,649	5,562	185	9.4 by 8.10, fixtures, s. l.	6	53 00	In March, 1876	237
8,892	5,441	14,243	10,021	334	10 by 6.6, f. f., s. l.	6	52 50	In March, 1876	238
8,512	7,586	16,104	12,750	425	-----	-----	52 00		239
10,007	12,240	22,256	9,926	330	14 by 7.2, f. f., s. l.	6	52 00		240
5,704	3,239	8,943	7,062	235	15 by 8.9, f. f., s. l.	7	52 00	In July, 1875. Extension.	241
5,179	1,758	6,937	6,771	225	b. c., nor. a.	12	52 00	In November 1875	242
10,689	20,039	30,728	13,088	436	10.6 by 9, f. f., s. l.	10 1/2	51 00		243
4,840	3,785	8,625	5,376	179	12 by 5, fixtures, s. l.	12	51 00		244
12,749	49,258	62,007	64,217	2,140	12 by 9, f. f., s. l.	12	50 00	In August, 1875	245
24,318	14,727	39,045	31,747	1,058	6.8 by 6.8, 6.6 by 5.3, 19.9 by 7.6, f. f., s. l.	18	50 00	In July, 1874; reported November, 1875.	246
15,649	7,308	22,957	19,354	645	freight-car, 24 by 8, f. f., s. l.	7	50 00	In August, 1875	247
17,404	7,229	24,633	18,962	632	12 by 9, s. l.	7	50 00	In June, 1876	248
20,220	19,196	39,416	15,560	518	14.7 by 9, f. f., s. l.	6 1/2	50 00		249
26,600	30,875	57,475	15,203	506	11 by 7, f. f., s. l.	7*	50 00	About 15 pounds per day not weighed.	250
7,176	8,883	16,059	14,003	466	b. c., nor. a.	26	50 00		251
-----	-----	-----	12,522	417	14.4 by 7.10, f. f., s. l.	11*	50 00	Part; residue \$100, (129.) 3.04 miles at \$18. See whole route, (123.)	252
14,127	10,378	24,505	11,944	398	14.6 by 6.10, fixtures, s. l.	12	50 00	In March, 1876	253
17,317	10,587	27,904	11,626	387	13.6 by 6.8, f. f., s. l.	7 1/2	50 00	In October, 1875. Main route; branch \$40, (414)	254
14,961	8,469	23,430	11,265	375	10 by 8, f. f., s. l.	6	50 00		255
17,321	12,224	29,545	11,173	372	10.5 by 7.3, f. f., s. l.	15 1/2	50 00		256
10,275	8,076	18,351	10,635	354	9.6 by 7.6, f. f., s. l.	9*	50 00	In November, 1875	257
-----	-----	-----	20,854	347	12 by 6, f. f., s. l.	7	50 00	60 days, in January and October, 1875.	258
11,440	7,702	19,142	10,356	345	11 by 6, f. f., s. l.	12*	50 00		259
8,512	5,067	13,579	10,287	342	11 by 7.4, f. f., s. l.	6	50 00	Branch; main route \$54, (234.)	260
12,208	10,544	22,752	10,211	340	13.8 by 6.8, fixtures, s. l.	9*	50 00	In April, 1875. Weighing voluntary.	261
3,790	7,285	11,075	10,142	338	7.6 by 7, f. f., s. l.	13	50 00		262
-----	-----	-----	9,935	331	11.7 by 7.7, f. f., s. l.	6	50 00	In July, 1874; reported November, 1875. Part; residue \$100, \$50, (122, 364.)	263
10,419	6,562	16,981	9,639	321	13 by 9, f. f., s. l.	6	50 00		264
12,343	6,766	19,109	9,628	320	13 by 8, f. f., d. l. to Northport, 164 m. s. l. res., 20 m.	12	50 00	In October, 1875	265
10,647	12,919	23,566	9,307	310	11.10 by 8, f. f., s. l.	12	50 00		266

*E.—Table showing the weight of the mails, the speed with which they*

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
267	S. C.	14010	14010	Port Royal, Augusta.....	Port Royal.....	<i>Miles.</i> 112.2	20
268	Ga.	6008	15009	Dupont, Bainbridge.....	Atlantic and Gulf.....	106.48	17.5
269	N. C.	5006	15006	Salisbury, Old Fort.....	Western North Carolina.....	114.31	12½
270	N. C.	13012	13012	Greensborough, Salem.....	Northwestern North Carolina.....	29.31	14½
271	Ill.	23053		East Saint Louis, Cairo.....	Cairo and Saint Louis.....	148.50	20
272	Ala.	17008	17008	Columbus, Troy.....	Mobile and Girard.....	90	18
273	N. Y.	1287		Oswego, Charlotte.....	Rome, Watertown and Ogdensburg.....	69.64	25
274	Ky.	20017	20017	Lexington, Mount Sterling..	Louisville, Cincinnati and Lexington.....	33.64	22
275	Ind.	22023	22024	Terre Haute, Danville.....	Evansville, Terre Haute and Chicago.....	56.6	22
276	Pa.	2431	8031	Columbia, Sinking Springs..	Reading and Columbia.....	39.70	20
277	Ohio	9024	21020	Freemont, Saint Mary's.....	Lake Erie and Louisville.....	29.35	20
278	Ga.	15016	15016	Smithville, Albany.....	Southwestern.....	23.78	17
279	Ind.	22027	22028	Rockville, Logansport.....	Logansport, Crawfordsville and Southwestern.....	92.10	22
280	S. C.	5608	14006	Florence, Cheraw.....	Cheraw and Darlington.....	40.82	16
281	Ohio	9041	21037	Niles, New Lisbon.....	Atlantic and Great Western.....	33.94	20
282	Ohio	9039		Youngstown, Cross Cut.....	Pittsburgh, Fort Wayne and Chicago.....	22.8	20
283	Ala.	17003	17003	Montgomery, Eufaula.....	Montgomery and Eufaula.....	81.24	16
284	Ill.	23050		Robinson, Danville.....	Paris and Danville.....	82.38	18
285	Ohio	9037	21033	Springfield, Columbus.....	Cincinnati, Sandusky and Cleveland.....	45.86	30
286	N. Y.	1223		Schenectady, Ballston.....	Delaware and Hudson Canal Company.....	16	30
287	Ala.	17006	17006	Marion Junction, Greensborough.....	Selma, Marion and Memphis.....	37.25	14
288	Me.	231		West Waterville, North Anson.....	Somerset.....	25.7	20
289	Ky.	2796a	20013	Anchorage, Shelbyville.....	Louisville, Cincinnati and Lexington.....	19	20
290	Del.	3406	9506	Georgetown, Selbyville.....	Breakwater and Frankford... ..	19.30	14
291	Iowa	27016		Washington, Oskaloosa.....	Chicago, Rock Island and Pacific.....	54.01	24
292	Miss.	18004	18004	Artesia, Columbus.....	Mobile and Ohio.....	14	10.5
293	Tenn.	19016	19001	Nashville, Lebanon.....	Tennessee and Pacific.....	32½	20
294	Ohio	9028		Hamilton, Indianapolis.....	Cincinnati, Hamilton and Indianapolis.....	99.49	25
295	N. Y.	1244		Cobleskill, Cherry Valley... ..	Delaware and Hudson Canal Company.....	22.47	30
296	N. Y.	1295		New York, Babylon.....	Southern, of Long Island.....	36.25	20
297	Ind.	22012a	22013	Terre Haute, Rockville.....	Logansport, Crawfordsville and Southwestern.....	23.23	22
298	Wis.	25026		Eau Claire, Chippewa Falls.....	Chippewa Falls and Western.....	11.67	25
299	Md.	3517	10016	Selbyville, Stockton.....	Worcester.....	31.44	14
300	N. Y.	1812		Rhine Cliff, Boston Corner.....	Rhinebeck and Connecticut... ..	35.2	18
301	Ky.	20015	20015	Owensborough, Owensborough Junction.....	Evansville, Owensborough and Nashville.....	36.13	15
302	S. C.	14001	14001	Belton, Anderson, Court-House.....	Greenville and Columbia.....	10.01	12
303	Vt.	532		White River Junction, Woodstock.....	Woodstock.....	14.53	18
304	Ind.	22025	22026	La Porte, Michigan City.....	Indianapolis, Peru and Chicago.....	19.36	21
305	Ala.	6603	17003	Montgomery, Eufaula.....	Montgomery and Eufaula.....	81.24	15
306	Ohio	9036	21032	Means, Cadiz.....	Pittsburgh, Cincinnati and Saint Louis.....	8	11
307	Tenn.	19004	19004	Wartrace Depot, Shelbyville.....	Nashville and Chattanooga....	8	10

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
14,119	20,378	34,497	15,632	306	10.6 by 6.10, f. f., a. l.	6	\$50 00	51 days, 21 from March 15 and 30 from May 15, 1876.	267
			18,271	304	12 by 8, 12 by 6, f. f., a. l.	7	50 00	60 days, in January and October, 1875. Branch: main route \$100, (124.)	268
12,734	5,129	17,863	8,565	285	10.3 by 8.3, f. f., a. l.	6	50 00	In October, 1875	269
5,766	3,587	9,353	8,537	284	21 by 8.2, f. f., a. l.	6	50 00		270
15,925	9,126	25,051	8,433	281	9 by 6, fixtures, a. l.	6	50 00	In March, 1876.	271
13,038	9,114	22,152	13,452	274	12 by 7, f. f., a. l.	6	50 00	7 trips from August 1, 1876, 49 days, 19 from March 15 and 30 from May 15, 1876.	272
								\$30 on 51.81 miles.	273
7,091	10,557	17,648	8,248	274	23 by 6.7½, f. f., a. l.	6	50 00		274
6,987	4,069	11,056	8,033	267	8.6 by 6, f. f., a. l., and b. c.	12	50 00		274
6,562	6,853	13,415	7,734	257	9.6 by 6.6, f. f., a. l.	13	50 00	In October, 1875	275
8,867	6,822	15,689	7,514	250	7.4 by 6.6, f. f., a. l.	18	50 00	Main route; branch \$50, (322.)	276
12,056	9,256	21,312	7,436	247	13 by 7, fixtures, a. l.	6	50 00		277
5,191	2,974	8,165	7,411	247	closet, 3 by 4; no r. a.	5*	50 00	Branch; main route \$70, (187.)	278
11,726	7,408	19,134	7,410	247	12 by 8.9, f. f., a. l.	6	50 00		279
7,310	3,344	10,654	7,362	245	20 by —, f. f., a. l.	6	50 00	In October, 1875	280
8,521	5,581	14,106	7,360	245	15.3 by 7.3, f. f., a. l.	6	50 00		281
4,455	6,092	10,547	7,167	239	12 by 9, f. f., a. l.	12	50 00	In August, 1875	282
9,952	9,060	19,016	11,204	233	9.5 by 6.6, f. f., a. l.	7½	50 00	48 days, 18 from March 15 and 30 from May 15, 1876.	283
5,066	8,635	13,639	6,991	213	12 by 7, fixtures, a. l.	6	50 00	In January, 1876.	284
5,370	4,553	10,225	6,867	222	16.8 by 6, f. f. and m. c., a. l.	6	50 00	In April, 1875	285
11,359	5,477	16,836	13,477	224	no r. a.	6	50 00	60 days, in May and August, 1875.	286
6,154	5,513	11,667	6,677	222	8.5 by 6.6, f. f., a. l.	6	50 00		287
5,462	3,266	8,668	6,620	220	12.6 by 6.6, f. f., a. l.	6	50 00	In March, 1876	288
5,712	4,557	10,269	6,510	217	r. a. in b. c., d. l.	12	50 00	In August, 1875	289
4,378	2,956	7,334	6,106	203	7 by 7, fixtures, a. l.	6	50 00		290
5,441	3,731	9,172	6,086	202	10 by 9, f. f., a. l.	6	50 00	In July, 1876.	291
3,828	2,241	6,069	6,069	202	in b. c., no r. a.	7	50 00	Branch; main route \$82, (153.)	292
5,381	2,476	7,857	6,055	201	r. a. in b. c.	6	50 00	In March, 1876.	293
8,728	8,701	17,429	5,746	191	10 by 9, f. f., a. l.	6	50 00	Returns for October, 1873, received October, 1875.	294
10,601	6,120	16,721	11,416	190	no apt.; no r. a.	6	50 00	60 days, in May and August, 1875.	295
7,325	4,944	12,269	5,576	185	12 by 6, f. f., a. l.	12	50 00	In August, 1875.	296
3,043	3,816	6,859	5,551	125	12 by 8.9, f. f., a. l.	6	50 00		297
3,739	2,037	5,776	5,498	183	b. c.; no r. a.	12	50 00	In May, 1876.	298
3,940	2,962	6,942	5,436	181	7 by 7, fixtures, a. l.	6	50 00	In March, 1876.	299
6,176	3,232	9,408	5,372	179	7 by 6, f. f., a. l.	6	50 00		300
3,067	4,931	7,998	5,354	178	9 by 6, f. f., a. l.	6	50 00		301
3,045	2,274	5,319	5,316	177	no r. a.	6	50 00	Branch; main route \$58, (213.)	302
3,935	3,134	7,068	5,300	176	b. c.; no r. a.	12	50 00	In January, 1876	313
2,737	2,649	5,386	5,243	174	12 by 7.1, f. f., a. l.	12	50 00		304
5,470	3,494	8,954	5,229	174	11.6 by 6.6, f. f., a. l.	6	50 00	In October, 1875.	305
3,566	1,823	5,389	5,173	172	b. c.; no r. a.	12	50 00	Branch; main route \$230, (36.)	306
3,301	1,830	5,031	5,031	167	in charge baggage-master	12	50 00	Branch; main route \$145, \$203, (46, 91.)	307

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
						<i>Miles.</i>	
308	N. C.	13002	13002	Rocky Mount, Tarborough.	Wilmington and Weldon.....	19. 79	15
309	N. Y.	1296	.....	Flushing, Whitestone.....	Flushing, North Side and Central.	3. 12	25. 5
310	Ill.	23042	.....	Terre Haute, Peoria.....	Illinois Midland.....	179. 93	27
311	Mich.	24036	.....	Grosse Ile, Fayette.....	Chicago and Canada Southern	70. 30	25
312	Ky.	20012	20012	Glasgow Junction, Glasgow.	Louisville and Nashville.....	12	16
313	Ill.	24043	.....	Streator, Altamont.....	Chicago and Paducah.....	156. 80	20
314	Md.	3512	10011	Cumberland, Piedmont.....	Cumberland and Pennsylvania	34	15
315	N. C.	13008	13008	Charlotte, Shelby.....	Carolina Central.....	55. 25	12
316	Ill.	23034	.....	Springfield, Gilman.....	Gilman, Clinton and Springfield.	111. 60	23
317	Cal.	46016	.....	Sancelito, Tomales.....	North Pacific Coast.....	49. 18	16
318	Ind.	22021	22022	Anderson Junction, Goshen	Cincinnati, Wabash and Michigan.	114. 32	20
319	Ohio	9048	21044	Harbor, Youngstown.....	Pennsylvania Company.....	62. 1	21
320	N. Y.	1296	.....	Bayside, Manhasset.....	Flushing, North Side and Central.	3. 3	25. 5
321	Ky.	20009	20009	Paducah, Trimble.....	Paducah and Memphis.....	76. 64	20
322	Pa.	2431	8031	Junction, Quarryville.....	Reading and Columbia.....	23. 20	13
323	N. Y.	1810	.....	Bath, Hammondsport.....	Bath and Hammondsport.....	9. 4	19
324	S. C.	5609	14007	Chester, Yorkville.....	Chester and Lenoir Narrow-Gauge Railroad, (late King's Mountain.)	24. 25	12
325	Fla.	16001	16001	Fernandina, Cedar Keys...	Atlantic, Gulf and West India Transit Company.	154. 8	16
326	Pa.	2496	8094	York, Delta.....	Peach Bottom.....	35. 56	15
327	Fla.	16004	16004	Toocoi, Saint Augustine.	Saint John's.....	15. 69	.....
328	Mass.	755	.....	North Brookfield, East Brookfield.	Boston and Albany Railroad Company, (lessees North Brookfield Railroad.)	4. 41	22
329	Wis.	25025	.....	Galena, Platteville.....	Galena and Southern Wisconsin.	30. 69	12
330	N. Y.	1261	.....	Hudson, Chatham.....	Hudson and Boston.....	35	20
331	Ind.	22015	22016	Fairland, Martinsville.....	Cincinnati and Martinsville..	32. 5	20
332	Pa.	2433	8033	York, Frederick.....	Pennsylvania.....	56	20
333	N. Y.	1288	.....	Theresa Junction, Clayton.	Utica and Black River.....	164	20
334	Ind.	22031	22032	Evansville, Bounville.....	Lake Erie, Evansville and Southwestern.	18	20
335	N. C.	13011	.....	Fayetteville, Sanford.....	Western.....	38. 53	18
336	S. C.	14008	14008	Allston, Spartanburgh Court-House.	Spartanburgh and Union.....	68. 12	11½
337	Tenn.	19005	19005	Fayetteville, Decherd.....	L. D. Hickerson and Anderson Powers, of Memphis and Charleston Railroad, lessees.	40	12
338	N. C.	13011	13011	Fayetteville, Sanford.....	Western.....	38. 53	15
339	Oreg.	44002	.....	Portland, Saint Joseph.....	Oregon Central.....	48. 61	12
340	Ga.	15008	15008	Kingston, Rome.....	Rome.....	20. 35	20
341	Ga.	15006	15006	Washington, Double Wells.	Georgia.....	18. 86	15
342	S. C.	14007	14007	Chester Court-House, Yorkville.	Chester and Lenoir Narrow-Gauge, (late King's Mountain.)	24. 25	12
344	Ohio	9025	.....	Carey, Findlay.....	Cincinnati, Sandusky and Cleveland.	16	16
345	Ga.	15014	15014	Gordon, Milledgeville.....	Central Railroad and Banking Company.	12. 25	12½
346	Pa.	2500	8098	New Castle, Stoneborough..	New Castle and Franklin.....	36. 5	15
347	S. C.	14001	14001	Cokesbury, Abbeville Court-House.	Greenville and Columbia.....	11. 81	12
348	Mich.	24026	.....	Grand Rapids, Morgan.....	Grand Rapids, Newaygo and Lake Shore.	36. 27	20
349	Ala.	6617	17017	Selma, Pine Apple.....	Selma and Gulf.....	43. 19	12



are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
3,225	1,700	4,925	4,925	166	10.6 by 7.6, furniture, a. l.	7	\$50 00	Branch; main route \$172, (66.)	308
3,639	2,290	5,929	4,890	163	12 by 6, f. f., a. l.	12	50 00	Branch; main route \$57, (221.) In August, 1875.	309
9,411	10,448	19,859	4,892	160	11.3 by 8.8, f. f., a. l.	6	50 00	In April, 1875.	310
5,957	5,200	11,155	4,814	160	10.9 by 9.3, f. f., a. l.	6	50 00		311
3,207	1,522	4,729	4,729	157	b. c.; no r. a.	10½	50 00		312
11,154	9,276	20,434	4,589	152	12 by 8, f. f., a. l.	6	50 00		313
3,214	5,221	9,035	4,491	149	9.6 by 6.9, f. f., a. l.	6	50 00	In March, 1876.	314
4,340	2,427	6,767	4,428	149	8 by 8, f. f., a. l.	6	50 00		315
6,155	8,657	14,812	4,473	149	11.6 by 7.6, f. f., a. l.	6	50 00	In March, 1875.	316
5,611	1,876	7,487	4,465	148	11 by 6, fixtures, a. l.	6	50 00	In May, 1876.	317
8,287	8,490	16,785	4,451	148	10.6 by 6.6, fixtures, a. l.	6	50 00		318
7,937	6,566	14,503	4,387	146	9.4 by 8.10, fixtures, a. l.	7½	50 00		319
2,732	1,881	4,613	4,325	144	no r. a.	12	50 00	Branch; main route \$57, (221.) In August, 1875.	320
6,974	4,936	11,910	4,268	142	9.3 by 6.10, f. f., a. l.	10*	50 00	15 m. per hour on last 15 m.	321
4,030	5,970	10,000	4,213	140	in b. c.	18	50 00	Branch; main route \$50, (376.)	322
2,503	2,156	4,659	4,180	139	in b. c.	15*	50 00		323
2,747	2,465	5,212	4,140	138	closet; no r. a.	6	50 00	In October, 1875.	324
9,712	5,570	15,282	4,095	136	12 by 5.6, f. f., a. l.	6	50 00		325
4,602	3,187	7,789	4,007	133	8.6 by 7.3, fixtures, a. l.	6	50 00	In March, 1876.	326
2,750	1,162	3,912	3,912	130			50 00		327
1,432	2,467	3,899	3,899	130	in b. c.	24	50 00	In March, 1876.	328
4,096	2,022	6,118	3,889	129	13 by 7, f. f., a. l.	6	50 00	In January, 1876.	329
3,364	2,064	5,428	3,881	129	b. c.; no r. a.	12	50 00	In January, 1876.	330
5,216	3,196	8,412	3,873	129	9 by 6.8, f. f., a. l.	6	50 00		331
5,271	4,844	10,115	3,867	128	5.6 by 3.2, fixtures, a. l.	64*	50 00	Main route; branch \$50.	332
2,647	1,354	3,997	3,865	128	in charge baggage-master	12	50 00	Part. In March, 1876.	333
			3,817	127	chest in express-car	12	50 00		334
3,281	2,177	5,458	3,815	127	10.9 by 6, fixtures, a. l.	6	50 00	In August, 1875. Main route; branch \$21, (446.)	335
3,683	3,377	7,060	3,702	123	7.1 by 6.5½, f. f., a. l.	6	50 00		336
2,688	3,963	6,651	3,638	121	10 by 6, f. f., a. l.	6	50 00		337
1,952	2,890	4,844	3,628	120	10.9 by 5.9, f. f., a. l.	6	50 00	Main route; branch \$50, (376.) In March, 1876.	338
3,917	2,761	6,678	3,606	120	8 by 8, f. f., a. l.	6	50 00	In September, 1875.	339
2,130	1,492	3,622	3,562	118	lock-box in pass. car; no r. a.	7	50 00		340
1,430	2,285	3,715	3,411	113	b. c.; no r. a.	6	50 00		341
2,442	1,900	4,342	3,313	110	9.3 by 7, f. f., no r. a.	6	50 00	Vacant. In March, 1876.	342
									343
1,131	2,441	3,572	3,199	106	in b. c., no r. a.	6	50 00	In April, 1875.	344
1,550	1,775	3,325	3,191	106	8.2 by 7, fixtures, a. l.	6	50 00		345
4,039	2,323	6,362	3,182	105	11 by 3.10, f. f., a. l.	6	50 00	In December, 1875.	346
1,696	1,460	3,156	3,156	105	no r. a.	6	50 00	Branch; main route \$50, (213.)	347
3,560	3,336	6,896	3,077	102	12 by 7, f. f., a. l.	6	50 00	In June, 1876. Co.'s return.	348
2,366	1,442	3,808	3,071	102	7.3 by 6, fixtures, a. l.	4	50 00	In October, 1875.	349

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Terminal.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
						<i>Miles.</i>	
350	Ga.	6007	15008	Kingston, Rome.	Rome	90.35	18
351	Cal.	46015		Elmira, Winters	Vaca Valley	18	20
352	S. C.	14003	14003	Kingsville, Camden	South Carolina	39.25	13
353	Md.	3520	10019	Emmitsburgh, Rocky Ridge	Emmitsburgh	7	21
354	Ohio	9031	2102	Xenia, Springfield	Pittsburgh, Cincinnati and Saint Louis	19	20
355	Ohio	9054	21050	Athens, Scott's Landing	Marietta and Cincinnati	37	12
356	Ala.	6611	17011	Gainesville, Gainesville Junction.	Mobile and Ohio	22	11
357	Ga.	15015	15015	Eatonton, Milledgeville	Central Railroad and Banking Company	22½	12½
358	Ala.	17016	17016	Opelika, Goodwater	Savannah and Memphis	59.65	15
359	Ala.	17005	17005	Tusculumbia, Florence	Memphis and Charleston	6.5	15
360	Tenn.	19003	19003	Rogersville, Bull's Gap	W. P. Elliott, proprietor Rogersville and Jefferson Railroad	15	16
361	Ga.	6005	15006	Washington, Double Wells	Georgia	18.25	25
362	Ill.	23032		McLeansborough, Shawneetown.	Salut Louis and Southeastern	41.25	14
363	Ohio	9052	21018	Dyson's, Cumberland	W. H. and C. B. Stevens, proprietors Eastern Ohio Railroad	7.8	15
364	N. J.	2123	7014	Dover, Chester	Morris and Essex	10	20
365							
366	Mass.	754		New Bedford, Fall River	Fall River	15	25
367	Ala.	17019	17019	Chehaw, Tuskegee	Tuskegee	6	12
368	Mass.	753		Ashburnham Depot, Ashburnham	Ashburnham	2.20	15
369	Ala.	17021	17021	Eufaula, Clayton	Vicksburgh and Brunswick	22.5	22
370	W. Va.	12005		Ritchie Court-House, Pennsborough.	Pennsborough and Harrisville	9	12
371	Ga.	15017	15017	Fort Valley, Perry	Southwestern	13.32	13
372	Ga.	6088	15017	do	do	13.32	15
373	Ala.	17030	17030	Atalla, Gadsden	East Alabama and Cincinnati	6	10
374	Mass.	617		Grafton, Millbury	Boston and Albany	4	22
375	Pa.	2493	8090	Phillipsburgh, Morrisdale Mines.	Pennsylvania	3.69	20
376	N. C.	13011	13011	Sanford, Egypt Depot	Western	6	15
377	Miss.	7007	18007	Muldon, Aberdeen	Mobile and Ohio	9	9
378	Pa.	2492	8089	Antestown, Lloydville	Bell's Gap	8.82	12
379	N. J.	2124	7027	Newark, Mount Clair	Newark and Bloomfield	5.67	23
380	Vt.	528		Wells River, Montpelier	Montpelier and Wells River	39.62	21
381	N. C.	13009	13009	Charlotte, Statesville	Atlantic, Tennessee and Ohio	49.34	15
382	Ill.	24054		Chicago, Byron	Chicago and Pacific	92.75	20
383	Pa.	2461	8061	Towanda, Bernice	Sullivan and Erie Coal and Railroad Company	29.32	14
384	Ala.	17011	17011	Gainesville, Gainesville Junction.	Mobile and Ohio	22	2½
385	Pa.	2494	8091	Reading, Slatington	Philadelphia and Reading Railroad Company, (lessors Berks County Railroad.)	43.32	18.5
386	Pa.	2499	8086	Hollidaysburgh, Royer	Pennsylvania	21.25	14
387	Pa.	2495a	8093	Larabee's, Clermont	McKean and Buffalo	23.3	15
388	N. Y.	1802		Quaker Street, Schenectady	Delaware and Hudson Canal Company	15	30
389	N. Y.	1803		Nineveh Junction, Jefferson Junction.	do	21	33
390	Ark.	7525a	29003	Chicot, Pine Bluff	Texas, Mississippi River and Northwestern	72.78	12
391	Ga.	15024	15024	Columbus, Hamilton	North and South	23.51	15
392	Ohio	9010	21009	Oneida Mills, Carrollton	Ohio and Toledo	12	15
393	Ill.	11913	23046	Aurora, Foreston	Chicago and Iowa	81.64	21
394	Ohio	9J50	21046	Painesville, Youngstown	Painesville and Youngstown	60.12	18

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Feet and inches.</i>				
1,643	1,426	3,069	3,069	102	b. c.; no r. a.	7	\$50 00	In October, 1875.	350
2,786	1,753	4,539	3,024	100	in b. c.; no r. a.	7	50 00	In August, 1876.	351
2,289	1,076	3,367	2,972	99	in charge of conductor	6	50 00	Branch; main route \$70, (188.)	352
1,139	1,747	2,886	2,886	96	in express-car	12	50 00	In January, 1876	353
2,332	1,893	4,225	2,677	89	in charge baggage-master	12	50 00	Part; res. \$210. (41.)	354
3,372	2,903	6,275	2,674	89	14.6 by 9.6, f. f., a. l.	6	50 00		355
1,183	1,710	2,893	2,623	87	in b. c.; no r. a.	7	50 00	In October, 1875.	356
921	1,823	2,744	2,572	85	8.2 by 7, fixtures, a. l.	6	50 00		357
3,693	2,445	6,138	2,326	77	8.2 by 7, f. f., a. l.	6	50 00	In March, 1876. 12.37 m. at \$40.	358
1,447	758	2,205	2,205	73	b. c.; no r. a.	7	50 00	Branch; main route \$160, (69.)	359
899	1,726	2,625	2,156	71	b. c.; no r. a.	6	50 00	In July, 1876	360
1,254	2,357	3,611	2,122	70	no r. a.	6	50 00	In October, 1875.	361
2,446	1,348	3,794	1,876	62	12 by 6.6, f. f., a. l.	6	50 00	Branch; main route \$110, (112.)	362
1,296	813	2,111	1,872	62	6 by 4, f. f.; no r. a.	12	50 00	In July, 1876	363
1,392	829	2,221	1,861	62	no apt.; no r. a.	9*	50 00	In July, 1874; reported November, 1875.	364
1,012	1,071	2,083	1,820	60	in b. c.	18	50 00	Vacant.	365
1,005	709	1,714	1,714	57	no apt.; no r. a.	14	50 00	In March, 1876.	366
1,151	560	1,711	1,711	57	do	12	50 00	In March, 1876	367
1,730	1,167	2,917	2,702	54	3 by 4, a. l.	6	50 00	50 days, 20 from March 15 and 30 from May 15, 1876.	369
778	918	1,696	1,628	54	10 by 7.4; no r. a.	12	50 00	In May, 1876	370
945	565	1,514	1,514	50	closet, 3 by 4; no r. a.	6	50 00	In March, 1876	371
963	532	1,495	1,495	49	3 by 4; no r. a.	6	50 00	In October, 1875.	372
286	495	781	761	25	13 by 9.6, f. f., a. l.	6	50 00		373
439	289	728	748	24	in b. c.	9*	50 00	In March 1876	374
439	253	692	692	23	b. c.; no r. a.	6	50 00	In August, 1875	375
162	283	445	445	15	10.9 by 5.9, f. f. In charge of conductor.	6	50 00	Branch; main route \$50, (338.)	376
197	137	334	334	11	in b. c.; no r. a.	14	50 00	In October, 1875	377
179	156	331	331	11	7 by 6.6; no r. a.	6	50 00	In August, 1875	378
4,328	1,929	6,256	4,738	157	no apt.; no r. a.	12	48 60	In July, 1874; reported November 1, 1875.	379
8,606	10,702	19,308	13,304	443	12 by 6.10, f. f., a. l.	6	45 00	In January, 1876	380
3,487	2,223	5,710	3,275	109	9 by 8, f. f., a. l.	6	45 00		381
6,887	4,403	11,290	2,914	97	22.6 by 10, f. f., a. l.	6	45 00	In January, 1876	382
3,827	1,997	5,824	2,686	96	8.3 by 7.3, fixtures, a. l.	6	45 00		383
1,176	1,671	2,847	2,591	86	in b. c.; no r. a.	7	45 00		384
4,231	3,161	7,392	2,447	81	6.9 by 5.2, f. f., a. l.	6	45 00	In August, 1875	385
2,681	1,939	4,620	2,442	81	b. c.; no r. a.	9.8*	45 00	do	386
2,403	1,280	3,683	1,846	61	8 by 5.6, (average,) fixtures, a. l.	6	45 00		387
2,705	2,140	4,845	3,436	57	no apt.	6	45 00	60 days, in May and August, 1875.	388
1,273	1,331	2,604	1,572	52	7 by 7, a. l.	6	45 00	In May, 1875	389
810	1,247	2,057	1,222	40	8 by 6, f. f., a. l.	3	45 00	In March, 1875	390
855	614	1,469	1,151	38	16 by 7; no r. a.	6	45 00		391
1,492	746	2,238	2,238	74	12 by 10; no r. a.	6	41 60		392
22,872	10,464	33,336	23,510	783	38 by 9.8, f. f. c., a. l.	12	40 00	In March, 1875	393
9,189	3,471	14,660	6,894	229	12 by 6, f. f., a. l.	6	40 00		394

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mails.	Length of route.	Miles per hour.
						Miles.	
395	Ind...	22011	22011	Cambridge City, Columbus..	Jeffersonville, Madison and Indianapolis.	68	20
396	Ill...	23029	.....	Urbana, Havana .....	Indianapolis, Bloomington and Western.	102.70	20
397	S. C...	14009	14009	Anderson Court-House, Walhalla.	Greenville and Columbia .....	35.06	15
398	Tenn.	19011	19011	Knoxville, Caryville .....	Knoxville and Ohio .....	33.94	12
399	Ill...	23029	.....	White Heath, Decatur .....	Indianapolis, Bloomington and Western.	32.35	12
400	Ky...	20006	20006	Bardstown Junction, Bardstown.	Louisville and Nashville .....	17.3	14
401	Ind...	22032	22033	Frankfort, Kokomo .....	Frankfort and Kokomo .....	25.5	20
401a	Ala...	17017	17017	Selma, Pine Apple .....	Selma and Gulf .....	43.19	10
402	N. J...	2118	7010	Greensburgh Station, New Brunswick.	Pennsylvania .....	29.13	25
403	Miss...	18008	18008	Middleton Station, Ripley...	Ripley .....	24.3	17
404	Tenn.	19012	19012	Morristown, Wolf Creek....	East Tennessee, Virginia and Georgia, (late Cincinnati, Cumberland Gap and Charleston.)	39.8	9
405	N. C...	5213	13009	Charlotte, Statesville .....	Atlantic, Tennessee and Ohio	49.32	15
406	Miss...	18009	18009	Durant, Kosciusko .....	New Orleans, Saint Louis and Chicago, (operating Mississippi Central.)	21.57	11
407	Miss...	7009	18009	.....do .....	.....do .....	21.57	12
408	N. J...	2120	7024	New Bridge, Stony Point...	New Jersey and New York ..	27.12	25
409	Minn.	26017	.....	Mankato, Wells .....	Central, of Minnesota .....	41.06	15
410	Ga...	15016	15016	Cuthbert, Fort Gaines .....	Southwestern .....	22.67	16
411	Tenn.	19014	19014	Memphis, Covington .....	Peach and Memphis .....	38.31	12
412	Pa...	2496	.....	York, Muddy Creek Forks...	Peach Bottom .....	22.09	12
413	Ala...	17014	17014	Opelika, Buffalo .....	East Alabama and Cincinnati	22.5	12
414	Ga...	6012	15013	Cochran, Hawkinsville .....	Macon and Brunswick .....	10	24
415	Ohio...	9040	21036	Logansport, New Straitsville.	Columbus and Hocking Valley	13.02	12
416	Pa...	2485	8092	Mechanicsburgh, Dillsburgh	Cumberland Valley .....	8.85	15
417	Ark...	7645a	29004	Chicot, Monticello .....	Texas, Mississippi River and Northwestern.	44.28	5
418	Ohio...	9043	21039	Clinton, Massillon .....	Cleveland, Mount Vernon and Delaware.	13.7	.....
419	Ga...	15013	15013	Cochran, Hawkinsville .....	Macon and Brunswick .....	10	16
420	Ga...	15019	15019	Barnesville, Thomaston .....	Central Railroad and Banking Company.	17.25	12
421	Ind...	22030	22031	Attica, Feedersburgh .....	Indiana North and South .....	14	13
422	Pa...	2498	8096	Oxford, Goshen .....	Peach Bottom .....	16.75	14
423	Ky...	20014	20014	Willard, Greenup .....	Eastern Kentucky .....	34.5	15
424	Md...	3519	10012	Lake Roland, Western Maryland Railroad Junction ..	Northern Central .....	8.5	17
425	Miss...	18007	18007	Muldon, Aberdeen .....	Mobile and Ohio .....	9	9
426	Ind...	22022	22023	Princeton, Albion .....	Louisville, New Albany and Saint Louis Air Line.	31.03	16
427	Ind...	22029	22030	Terre Haute, Marts .....	Cincinnati and Terre Haute...	26.15	18
428	Ind...	22033	22034	Rockport, Huntingburgh .....	Cincinnati, Rockport and Southwestern.	31.02	15
429	Ga...	15016	15016	Albany, Arlington .....	Southwestern .....	35.5	14
430	Kans...	33014	.....	Fort Scott, Memphis .....	Fort Scott, Southeastern and Memphis.	6.52	12
431	Mo...	28031	.....	Saint Louis, Normandy .....	West End Narrow Gauge .....	10.53	15
432	Ga...	6146	15022	Griffin, Carrollton .....	Savannah, Griffin and North Alabama.	59.66	12
433	S. C...	5602	14001	Cokesbury, Abbeville Court House.	Greenville and Columbia .....	11.81	15
434	S. C...	5602	14001	Belton, Anderson Court-House.	.....do .....	10.01	15

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Feet and inches.				
7,130	5,497	12,627	4,880	162	11 by 6, f. f., a. l.	6	\$40 00		395
7,756	7,699	15,455	4,338	144	10 by 7, furniture, a. l.	6	40 00	In November, 1875. Main route; branch \$40, (399.)	396
3,109	2,783	5,892	4,017	133	12 by 8, f. f.	6	40 00		397
3,093	2,181	5,274	3,637	121	6.2 by 3, fixtures, a. l.	6	40 00		398
2,666	3,232	5,924	3,636	121	8 by 4, furniture, a. l.	6	40 00	Branch; main route \$40, (396.) In November, 1875.	399
2,947	1,805	4,752	3,434	114	b. c.; no r. a.	7	40 00		400
2,566	2,728	5,294	3,399	112	10.10 by 7.2, f. f., a. l.	12	40 00		401
4,276	2,322	6,664	5,330	110	7.3 by 6, f. f., a. l.	4	40 00	48 days, 18 from March 15 and 30 from May 15, 1876.	401
4,045	3,591	7,636	3,206	106	in b. c.; no r. a.	6	40 00	In October, 1875	402
2,150	1,902	4,052	2,881	96	in b. c.; no r. a.	6	40 00		403
2,239	2,971	5,210	2,822	94	12 by 7, f. f., a. l.	6	40 00		404
2,439	3,354	5,893	2,897	89	9 by 8, f. f., a. l.	6	40 00	In October, 1875	405
1,891	884	2,775	2,531	81	in b. c.; no r. a.	6	40 00	In March, 1876	406
1,623	1,106	2,729	2,527	84	b. c.; no r. a.	6	40 00	In October, 1875	407
3,515	2,109	5,624	2,500	83	do.	6	40 00	In March, 1876	408
1,842	1,637	3,479	2,485	83	8.3 by 7, f. f., a. l.	6	40 00	In October, 1875	409
1,667	884	2,551	2,429	80	closet, 3 by 4; no r. a.	6	40 00	Branch; main route \$70, (187.)	410
2,847	2,062	4,929	2,921	76	8.6 by 6.6, f. f., a. l.	6	40 00		411
			2,260	75	b. c.; no r. a.	7½	40 00	In September, 1875	412
1,707	1,153	2,860	2,188	72	8 by 4, f. f., a. l.	6	40 00		413
1,244	944	2,188	2,188	72	no r. a.	6	40 00	Branch; main route \$50, (254.) In October, 1875.	414
1,220	990	2,210	1,886	62	in b. c.; no r. a.	15*	40 00	Branch; main route \$87.50, (151.)	415
1,022	822	1,844	1,740	58	locked box in b. c.	6	40 00	In August, 1875	416
1,428	835	2,263	1,724	57	no r. a.	2	40 00	In March, 1875	417
1,192	1,090	2,282	1,688	56			40 00		418
974	706	1,680	1,680	56	13 by 8.6, fixtures; no r. a.	6	40 00	Branch; main route \$65, (192.)	419
1,020	743	1,763	1,531	51	closet 3 by 4; no r. a.	6	40 00		420
1,022	1,114	2,136	1,292	43	in b. c.	6	40 00		421
976	691	1,667	1,092	36	b. c.; no r. a.	6	40 00	In January, 1876	422
1,169	1,921	3,090	997	33	10 by 4.6, f. f., a. l.	6	40 00		423
496	335	831	703	23	in b. c.; no r. a.	6	40 00		424
138	151	289	289	9	in b. c.; no r. a.	7	40 00	In March, 1876	425
1,965	1,130	3,115	1,740	58	r. a. in caboose-car, f. f., a. l.	6	35 00		426
2,154	1,427	3,581	1,681	56	no apt., a. l.	6	35 00		427
1,518	1,053	2,571	1,441	48	10 by 9; in charge of conductor.	6	35 00		428
1,028	707	1,735	1,158	38	closet 3 by 4; no r. a.	5*	35 00	Branch; main route \$70, (187.)	429
725	261	986	986	32	in b. c.	6	35 00	In March, 1876	430
524	394	918	788	27	in b. c.; no r. a.	6	35 00	In May, 1876	431
3,119	3,626	6,745	3,330	107	8.6 by 4.6, f. f., a. l.	6	30 00	In December, 1875	432
1,406	1,720	3,126	3,126	104	in charge of conductor	6	30 00	Branch; main route \$75, (182.)	433
1,081	1,803	2,884	2,884	96	12 by 7, f. f., a. l.	6	30 00	In October, 1875. Branch; main route \$75, (182.)	434

E.—Table showing the weight of the mails, the speed with which they

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Miles per hour.
						<i>Miles.</i>	
435	Ala...	17005	17005	Moecow, Somerville.....	Memphis and Charleston.....	14.5	18
436	Ala...	6614	17014	Opelika, Buffalo.....	East Alabama and Cincinnati.	22.50	20
437	Ala...	17018	17018	Mobile, Bigbee Bridge.....	Mobile and Alabama Grand Trunk.	59.7	15
438	Ga....	15023	15023	Brunswick, Albany.....	Brunswick and Albany.....	173.31	14½
439	Tenn...	19015	19015	Jasper, Bridgeport.....	Nashville and Chattanooga....	12	10
440	Ga....	15020	15020	Cartersville, Rock Mart.....	Cherokee.....	22.08	12
441	Ky...	20001	20001	Ashland, Geigersville.....	Lexington and Big Sandy.....	13.98	12
442	Fla...	16002	16002	Tallahassee, Saint Mark's...	Jacksonville, Pensacola and Mobile.	21.89	16
443	Fla...	16005	16005	Pensacola, Millview.....	Pensacola and Perdido.....	104	12
444	Pa....	2499	8097	Pittsburgh, Castle Shannon.	Pittsburgh and Castle Shannon	7	12
445	Ky...	9605	20001	Ashland, Coalton.....	Lexington and Big Sandy.....	11	12
446	N. C...	5216	13011	Sanford, Egypt Depot.....	Western.....	7	.....
447	La....	8003	30005	Baton Rouge, Livonia.....	Baton Rouge, Grosse Tête and Opelousas.	28	10

are conveyed, the accommodations for mails and agents, &c.—Continued.

Whole weight carried any distance for thirty days.			Average weight carried whole distance.		Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Remarks.	Order.
Outward.	Inward.	Total.	30 days, total.	Per day, total.					
<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Feet and inches.</i>				
1,338	914	2,272	2,272	75	in b. c.; no r. a. ....	7	\$30 00	Branch; main route \$180, (69.)	435
1,433	817	2,250	1,635	54	8 by 4, f. f., a. l. ....	6	30 00	In October, 1875 .....	436
1,288	938	2,226	1,648	54	in passenger-car; no r. a. ....	6	30 00	.....	437
3,361	3,354	6,715	1,089	36	12 by 8.6, f. f., $\frac{1}{2}$ l. ....	3	30 00	.....	438
453	827	1,280	1,108	36	in charge of baggage-master.	6	30 00	.....	439
933	619	1,552	1,053	35	5 by 3, in b. c.; no r. a. ....	6	30 00	.....	440
443	194	637	637	21	locked box, 2.6 by 1.6; no r. a.	6	30 00	.....	441
452	581	1,033	1,033	17	no apt.; in charge of conductor.	3	30 00	Branch; main route \$90, (146.) 60 days, half from Nov. 15, 1875, and residue from Jan. 1, 1876.	442
298	900	498	498	16	in passenger-car; no r. a. ....	6	30 00	.....	443
352	303	655	475	15	no r. a. ....	6	30 00	.....	444
645	379	1,024	1,024	34	locked box; no r. a. ....	6	29 54	In April, 1875 .....	445
290	411	701	701	23	no r. a. ....	6	21 00	Branch; main route \$50, (335.) In August, 1875.	446
211	180	391	391	10	in passenger-car .....	3	12 86	In September, 1875 ....	447

THOMAS J. BRADY,  
Second Assistant Postmaster-General.

## Index to Table E.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Adirondack.....	186	1804		Charlotte, Columbia and Augusta	101	13007	13007
Alabama Central.....	324	17009	17009	Cheraw and Darlington.....	236	14006	14006
Arkansas Valley.....	305	38005		Do.....	280	5808	14006
Ashburnham.....	368	753		Cherokee.....	440	15020	15020
Atchison and Nebraska.....	303	33009		Chester and Lenoir Narrow			
Atchison, Topeka and Santa Fé.	167	33013		Gauge, (late King's Mountain)	324	5609	14007
Atlanta and Richmond Air Line.	131	15001	15001	Do.....	343	14007	14007
Atlanta and West Point.....	98	6003	15003	Chicago and Canada Southern.....	311	24036	
Atlantic and Great Western.....	123	9006	21005	Chicago and Pacific.....	382	23054	
Do.....	129	9006	21005	Chicago and Iowa.....	141	11913	23036
Do.....	144	9023	21034	Do.....	393	11913	23036
Do.....	252	9006	21005	Chicago and Paducah.....	313	22043	
Do.....	281	9041	21037	Chicago, Burlington and Quincy.	53	23010	
Atlantic and Gulf.....	104	15009	15009	Do.....	54	23010	
Do.....	124	6008	15009	Do.....	159	27011	
Do.....	301	15018	15018	Do.....	161	27011	
Do.....	217	15009	15009	Chicago, Cincinnati and Louis-			
Do.....	258	6016	15018	ville.....	225	23014	23015
Do.....	268	6008	15009	Chicago, Rock Island and Pa-			
Atlantic and North Carolina.....	326	13005	13005	cific.....	291	27016	
Atlantic, Gulf and West India				Chippewa Falls and Western.....	298	25026	
Transit Company.....	325	16001	16001	Cincinnati and Martinsville.....	331	22015	23016
Atlantic, Tennessee and Ohio.....	381	13009	13009	Cincinnati and Terre Haute.....	427	22029	22030
Do.....	405	5213	13009	Cincinnati, Cumberland Gap and			
Baltimore and Ohio.....	14	3503		Charleston. (See East Ten-			
Do.....	15	3503		nessee, Virginia and Georgia.)			
Do.....	18	3504	10003	Cincinnati, Hamilton and Day-			
Do.....	19	12002		ton.....	55	2030	21026
Do., (operating Baltimore,				Do.....	56	2030	21026
Pittsburgh and				Do.....	83	2030	21026
Chicago).....	34	9051	21047	Cincinnati, Hamilton and In-			
Do.....do.....	51	9051	21047	dianapolis.....	256	2028	21024
Do., (leaves Sandusky,				Do.....	294	2028	21024
Mansfield and New-				Cincinnati, La Fayette and Chi-			
ark).....	74	9011	21010	cago.....	22	22028	22029
Do.....	75	9011	21010	Cincinnati, Richmond and Chi-			
Do.....	76	9011	21010	cago.....	106	2029	21025
Do.....	78	9011	21010	Cincinnati, Richmond and Fort			
Do.....	79	9011	21010	Wayne. (See Grand Rapids			
Do.....	80	9011	21010	and Indiana.)			
Baltimore and Potomac.....	90	3514	10013	Cincinnati, Rockport and South-			
Do.....	118	3514		western.....	428	22033	22034
Do.....	119	3514		Cincinnati, Sandusky and Cleve-			
Baltimore, Pittsburgh and				land.....	136	2013	21012
Chicago. (See Baltimore and				Do.....	150	2013	21012
Ohio.).....				Do.....	239	2037	21033
Bath and Hammondsport.....	323	1810		Do.....	285	2037	21033
Baton Rouge, Grosse Tête and				Do.....	344	2025	21021
Opelousas.....	447	8003	30005	Cincinnati, Wabash and Michi-			
Bell's Gap.....	378	2492	8089	gan.....	318	22021	22022
Berks County. (See Pennsyl-				Cleveland and Pittsburgh.....	77	2007	21006
vania.).....				Do.....	121	2003	21003
Boston and Albany, (leaves				Do.....	264	2009	21008
North Brookfield Railroad).....	328	755		Cleveland, Columbus, Cincin-			
Boston and Albany.....	374	617		nati and Indianapolis.....	33	2046	21042
Breakwater and Frankford.....	290	3406	9506	Do.....	58	2018	21016
Brunswick and Albany.....	438	15023	15023	Do.....	105	2015	21013
Buffalo and Jamestown.....	198	1290		Cleveland, Mount Vernon and			
Cairo and Saint Louis.....	271	23053		Delaware.....	107	2005	21004
Carolina Central.....	227	13003	13003	Do.....	418	2043	21039
Do.....	315	13008	13008	Cleveland, Tuscarawas Valley			
Cayuga.....	257	1284		and Wheeling, (late Lake			
Central, of Minnesota.....	409	26017		Shore and Tuscarawas Val-			
Central, of New Jersey.....	23	2101	7001	ley).....	249	2045	21041
Do.....	190	2258	7003	Columbus and Hocking Valley.....	151	2040	21036
Central Ohio.....	25	9001	21001	Do.....	415	2040	21036
Do.....	26	9001	21001	Columbus and Xenia.....	42	2016	21014
Do.....	27	9001	21001	Columbus, Chicago and Indiana			
Central Pacific.....	35	46001		Central.....	67	2017	21015
Central Railroad and Banking				Consolidated European and			
Company.....	111	15019	15019	North American.....	147	244	
Do.....	160	15010	15010	Cumberland and Pennsylvania.....	314	2318	10011
Do.....	164	15005	15005	Cumberland Valley.....	416	2435	2062
Do.....	345	15014	15014	Dayton and Michigan.....	85	2027	21023
Do.....	357	15015	15015	Dayton and Union.....	207	2026	21022
Do.....	420	15019	15019	Delaware and Hudson Canal Co.	81	1222	
				Do.....	84	1221	



## Index to Table E—Continued.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Delaware and Hudson Canal Co.	86	1290	.....	Hudson and Boston	330	1261	.....
Do	82	1294	.....	Illinois Midland	310	23048	.....
Do	95	1294	.....	Indiana, North and South	421	23030	23031
Do	116	1294	.....	Indianapolis and Saint Louis	59	23028	.....
Do	132	1245	.....	Do	63	23028	23028
Do	153	1294	.....	Indianapolis and Vincennes	255	23001	23001
Do	286	1293	.....	Indianapolis, Bloomington and Western	396	23029	.....
Do	295	1244	.....	Do	399	23029	.....
Do	382	1802	.....	Indianapolis, Cincinnati and La Fayette	24	22003	22003
Do	389	1803	.....	Do	29	22005	22005
Delaware, Lackawanna and Western	246	2122	7028	Indianapolis, Peru and Chicago	138	22004	22004
Do (See Newark and Bloomfield.)				Do	304	22025	22026
Detroit, Eel River and Illinois	240	22026	22027	Jacksonville, Pensacola and Mobile	146	16002	16002
East Alabama and Cincinnati	373	17020	17020	Do	442	16002	16002
Do	413	17014	17014	Jeffersonville, Madison and Indianapolis	94	22007	22007
Do	436	6614	17014	Do	259	22006	22006
East Tennessee, Virginia and Georgia	32	13009	19002	Do	395	22011	22011
Do	120	19009	19002	Do	183	3513	10012
Do	404	19012	19012	Kent County	113	20002	20002
Eastern Kentucky	423	20014	20014	Kentucky Central	114	20002	20002
Eastern Ohio. (See W. H. and C. B. Stevens.)				Do	175	20002	20002
Elliott, W. P., proprietor, Rogersville and Jefferson Railroad	360	19003	19003	King's Mountain. (See Cheater and Lenoir Narrow-Gauge.)	398	19011	19011
Emmitsburgh	353	3520	10019	Knoxville and Ohio	277	9024	21020
Errie	2	1201	.....	Lake Erie and Louisville			
Do	17	1208	.....	Lake Erie, Evansville and Southwestern	334	22031	22032
Erie and Pittsburgh	157	2445	2045	Lake Shore and Michigan Southern	1	9008	21007
Evansville and Crawfordville	127	22012	22012	Do	4	9049	21045
Evansville, Owensborough and Nashville	301	20015	20015	Do	5	1241	.....
Evansville, Terre Haute and Chicago	231	22023	22024	Do	9	1241	.....
Do	275	22023	22024	Do	10	1241	.....
Fall River	366	754	.....	Do	11	1241	.....
Finishing, North Side and Central	221	1296	.....	Lexington and Big Sandy	441	9605	20001
Do	309	1296	.....	Do	445	9605	20001
Do	320	1296	.....	Little Rock and Fort Smith	154	29005	.....
Fort Wayne, Jackson and Saginaw	223	24008	.....	Logansport, Crawfordville and Southwestern	279	22027	22028
Do	243	24008	.....	Do	297	22012a	22013
Fort Wayne, Muncie and Cincinnati	214	22019	22020	Long Island	229	1206	.....
Fort Scott, Southeastern and Memphis	430	33014	.....	Do	265	1234	.....
Frankfort and Kokomo	401	22039	22033	Louisville and Nashville	31	20005	20005
Galena and Southern Wisconsin	329	25025	.....	Do	57	20008	20008
Georgia	89	15004	15004	Do	60	19009	19009
Do	100	6001	15004	Do	64	19010	19010
Do	177	6006	15007	Do	93	19010	19010
Do	196	6006	15007	Do	148	19006	19006
Do	341	6005	15006	Do	228	20007	20007
Do	361	6005	15006	Do	229	20007	20007
Gilman, Clinton and Springfield	316	22034	.....	Do	234	20007	20007
Grand Gulf and Port Gibson	184	18006	18006	Do	260	20007	20007
Grand Rapids and Indiana	253	22020	22021	Do	312	20012	20012
Do	261	22020	22021	Do	400	20006	20006
Grand Rapids, Newaygo and Lake Shore	348	24028	.....	Louisville, Cincinnati and Lexington	52	20004	20004
Greenville and Columbia	182	5602	14001	Do	61	20018	20018
Do	213	14001	14001	Do	143	20003	20003
Do	302	14001	14001	Do	244	20013	20013
Do	347	14001	14001	Do	274	20017	20017
Do	397	14009	14009	Do	289	2796a	20013
Do	433	5602	14001	Louisville, New Albany and Chicago	250	22008	22008
Do	434	5602	14001	Louisville, New Albany and Saint Louis Air Line	426	22022	22023
Hannibal and Saint Joseph	128	22030	.....	McKean and Buffalo	387	2495a	8093
Hickerson, L. D., and Anderson Powers, of Memphis and Charleston Railroad, lessees	337	19005	19005	Macon and Augusta	230	15021	15021
Houston and Texas Central	73	31003	.....	Macon and Brunswick	192	15013	15013
Do	130	31004	.....	Do	254	6012	15013
Do	169	31005a	.....	Do	414	6012	15013
				Do	419	6012	15013
				Macon and Western	126	6011	15012
				Marietta and Cincinnati	16	9032	21028

## Index to Table E—Continued.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Marietta and Cincinnati	70	9030	21018	Paducah and Memphis	321	20009	20009
Do.	156	9019	21017	Do	411	19014	19014
Do.	251	9053	21049	Painesville and Youngstown	394	9050	21046
Do.	355	9054	21050	Paris and Danville	284	23050	
Maryland and Delaware	238	3403	9503	Peach Bottom	326	2496	8094
Mayeville and Lexington	210	20016	20016	Do	412	2496	
Memphis and Charleston	69	17005	17005	Do	422	2498	8096
Do.	359	17005	17005	Pennsborough and Harrisville	370	19005	12005
Do.	435	17005	17005	Pennsylvania	3	2103	7004
Do. (See L. D. Hickerson and Anderson Powers.)				Do	12	2401	
Mississippi and Tennessee	163	7002	18002	Do	13	2401	8001
Do.	191	18002	18002	Do	149	2103	7004
Mississippi Central. (See New Orleans, Saint Louis and Chicago.)				Do	332	2433	8033
Missouri, Kansas and Texas	37	28011		Do	375	2493	8090
Do.	39	28014		Do	386	2489	8086
Do.	212	33006		Pennsylvania Company	204	9047	21043
Mobile and Alabama Grand Trunk	437	17018	17018	Do	319	9048	21044
Mobile and Girard	272	17008	17008	Pensacola and Louisville	262	16003	16003
Mobile and Montgomery	89	17012	17012	Pensacola and Perdido	443	16005	16005
Mobile and Ohio	103	7004	18004	Peoria, Pekin, and Jacksonville	180	23038	
Do.	155	7004	18004	Petersburgh	50	4410	11009
Do.	208	7004	18004	Philadelphia and Reading. (See Berks County Railroad.)	381	2494	8091
Do.	292	18004	18004	Pittsburgh and Castle Shannon	444	2499	6097
Do.	356	6611	17011	Pittsburgh, Cincinnati, and Saint Louis	36	9036	21032
Do.	377	7007	18007	Do. (Little Miami division)	41	9031	21027
Do.	384	17011	17011	Do	142	9012	21011
Do.	425	18007	18007	Do	166	22013	22014
Montgomery and Eufaula	283	17003	17003	Do	168	22009	22009
Do.	305	6603	17003	Do	178	9033	21029
Montpelier and Wells River	380	528		Do	193	9034	21030
Morris and Essex	122	2106	7013	Do	266	22016	22017
Do.	125	2106	7013	Do	306	9036	21032
Do.	263	2106	7013	Do	354	9031	21027
Do.	364	2123	7014	Pittsburgh, Fort Wayne and Chicago	22	9002	
Nashville and Chattanooga	46	19004	19004	Do	38	9002	21002
Do.	48	19004	19004	Do	43	9002	
Do.	90	19004	19004	Do	44	9002	21002
Do.	91	19004	19004	Do	237	9039	21035
Do.	92	19004	19004	Do	245	2429	8029
Do.	165	19007	19007	Do	282	9039	
Do.	307	19004	19004	Portland and Ogdensburg	99	410	
Do.	439	19015	19015	Port Royal	267	14010	14010
Newark and Bloomfield	379	2124	7027	Raleigh and Augusta Air Line	235	13010	13010
Newark, Somerset, and Straitsville	185	9042	21038	Raleigh and Gaston	176	13001	13001
New Castle and Franklin	346	2500	8098	Reading and Columbia	276	2431	8031
New Jersey and New York	408	2120	7024	Do	322	2431	8031
New Orleans, Mobile and Texas	96	17013	17013	Rhinebeck and Connecticut	300	1512	
New Orleans, Saint Louis and Chicago	69	18001	18001	Richmond and Danville	66	13004	13004
Do.	406	18009	18009	Do	97	4407	13004
Do. (operating Mississippi Central)	407	7009	18009	Do	173	13004	13004
Newport and Wickford Railroad and Steamboat Company	215	825		Richmond and Petersburg	40	4409	11008
New York Central and Hudson River	6	1217		Ripley	403	18008	18008
Do.	7	1211		Rogersville and Jefferson. (See W. P. Elliott.)			
Do.	8	1211		Rome	340	6007	15008
Do.	242	1811		Do	350	6007	15008
North and South	391	15024	15024	Rome, Watertown and Ogdensburg	273	1287	
Northeastern	102	5607	14005	Saint John's	327	16004	16004
Do.	108	14005	14005	Saint Louis and Southeastern	109	19008	19008
Northern Central	87	1255		Do	112	23032	
Do.	424	3519	10018	Do	115	20010	20010
North Pacific Coast	317	46016		Saint Louis, Lawrence and Western	216	28016	
Northwestern. (North Carolina)	270	13012	13012	Saint Louis, Rock Island and Chicago	195	23005	
Ohio and Mississippi	30	22010	22010	San Francisco and North Pacific	244	46011	
Do.	65	25018	22019	Savannah and Charleston	110	14004	14004
Ohio and Toledo	392	9010	21009	Savannah and Memphis	352	17016	17016
Oregon Central	339	44002					

## Index to Table E—Continued.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Savannah, Griffin and North Alabama	432	6146	15022	Utah Southern	199	41002	.....
Seaboard and Roanoke	181	4415	11015	Do	241	41002	.....
Selma and Gulf	349	6617	17017	Utica and Black River	172	12288	.....
Do	4012	17017	17017	Do	218	12288	.....
Selma, Marion and Memphis	287	17006	17006	Do	219	12288	.....
Selma, Rome and Dalton	139	6610	17010	Do	222	12288	.....
Do	171	6610	17010	Do	333	12288	.....
Somerset	288	231	.....	Vaca Valley	351	46015	.....
South and North Alabama	170	17004	17004	Vicksburgh and Brunswick	369	17021	17021
Southern, of Long Island	296	1295	.....	Vicksburgh and Meridian	133	18003	18003
Southern Pacific	206	46017	.....	Do	209	18003	18003
South Carolina	162	14003	14003	Do	241	18003	18003
Do	188	14003	14003	Virginia and Truckee	1852	45001	.....
Do	189	14003	14003	West End Narrow Gauge	431	28031	.....
Do	352	14003	14003	Western	335	13011	.....
Southwestern	140	15011	15011	Do	338	13011	13011
Do	187	15016	15016	Do	376	13011	13011
Do	278	15016	15016	Do	446	5216	13011
Do	371	15017	15017	Western and Atlantic	47	15002	15002
Do	372	6088	15017	Western Maryland	174	3507	10006
Do	410	15016	15016	Western North Carolina	220	13006	13006
Do	429	15016	15016	Do	269	5006	13006
Spartanburgh and Union	336	14008	14008	Western, of Alabama	117	17001	17001
Sullivan and Erie Coal and Railroad	383	2461	8061	Do	197	17007	17007
Stevens, W. H. and C. B., (proprietors Eastern Ohio)	363	9052	21048	Do	233	17002	17002
Tennessee and Pacific	293	19016	19001	West Jersey	137	2111	7019
Terre Haute and Indianapolis	45	22002	22002	Do	179	2112	7020
Do	49	23031	.....	Do	202	2113	7021
Texas, Mississippi River and Northwestern	390	7525a	28003	West Wisconsin	135	25014	.....
Do	417	7545a	28004	White Water Valley	200	9035	21031
Toledo, Canada Southern and Detroit	152	24035	.....	Wilmington and Weldon	66	13002	13002
Toledo, Wabash and Western	145	9022	.....	Do	308	13002	13002
Tuskegee	367	17019	17019	Wilmington, Columbia and Augusta	71	14002	14002
Union Pacific	21	34 01	.....	Do	72	14002	14002
Utah Northern	247	41003	.....	Do	134	14002	14002
				Winchester and Alabama. (See Memphis and Charleston.)			
				Woodstock	303	532	.....
				Worcester	299	3517	10016

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes in States and on certain new routes the adjustment of the rates, based upon returns of the weight of and the number of trips per week, in accordance with the act of March 3, 1873; and with the

[ABBREVIATIONS.—f. f., fixtures and furniture; f. f. c., fixtures and furniture complete; m. c., mail-line; d. l., double line; t. l., triple line; m., miles; r. a., route-agents; m. m., mail-messenger. A num-tabular form being inconvenient. The figures in parentheses in the "Remarks" column refer to the

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
1	N. Y.	1217	.....	Albany, Buffalo.....	New York Central and Hudson River.	Miles. 298	Pounds. 56, 074	45, 30
2	N. Y.	1241	..... {	Cleveland, Elyria ..... Millbury, Toledo.....	{ Lake Shore and Michigan { Southern.	25.7 8.5	{51, 102	32, 28
3	N. Y.	1241	.....	Buffalo, Cleveland.....	.....do.....	184.5	51, 102	32, 28
4	N. Y.	1211	.....	New York, Albany...	New York Central and Hudson River.	144	52, 663	45, 30
5	N. J.	2103	7004	New York, West Philadelphia.	Pennsylvania .....	90	49, 637	28
	Ohio...	9008	21007	Elyria, Millbury .....	Lake Shore and Michigan Southern.	74.98	45, 463	32, 28
7	N. Y.	1241	.....	Elkhart, Chicago.....	.....do.....	101	37, 412	32, 28

in which the contract-term expired June 30, 1876, and also in other States and Territories, the mails, the speed with which they are conveyed, the accommodations for mails and agents, act of July 12, 1876, in the case of re-adjustments taking effect on and after July 1, 1876.

catchers; r. p. o., railway post-office; apt., apartment; b. c., baggage-car; l., line or lines; a. l., single letter followed by an asterisk (\*) shows the equivalent in round trips, a more particular statement in order of the routes in this table.]

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i> r. p. o., fast mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9, and 1 l.; 47 by 9, (average.)	34	1,028 00	602 00	306,344 00	179,396 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Pay to be fixed on new returns from July 23, 1876, date of discontinuance of fast mail. Average speed, 45 miles fast mail; 30 miles residue.	1
r. p. o., 38 by 9, (average,) 1 l.; 18 by 9, 1 l.; 45 by 9, (average,) 1 l.; fast mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9.	17½*	1,001 00	615 00	34,234 20	21,033 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Average speed, 39 miles fast mail; 28 miles residue. Part; residue \$989.75, \$817.50, \$199.25, \$197.37½, (3, 7, 47, 48.)	•
r. p. o., 38 by 9, (average,) 1 l.; 45 by 9, (average,) 1 l.; fast mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9.	17½*	989 75	590 00	182,608 87	102,855 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Average speed, 39 miles fast mail; 28 miles residue. Part; residue \$1,001, \$817.50, \$199.25, \$197.37½, (2, 7, 47, 48.)	3
r. p. o., fast mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9; and 1 l. 47 by 9, (average.)	47*	985 00	597 00	141,840 00	85,968 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Part; residue \$140, (71.) Average speed, 45 miles fast mail; 30 miles residue. Pay to be fixed on new returns from July 23, 1876, date of discontinuance of fast mail.	4
r. p. o., 46 by 8.7, f. f. c., 3 l.; 58.6 by 8.5, f. f. c., 1 l.; tender, 29 by 7.9, f. f. c., 1 l.; r. a. apt., (average,) 15.4 by 6.6, 1 l. through; 8 by 6.4, 1 additional to Monmouth Junction, 49 m.	49½*	915 00	628 00	82,350 00	56,520 00	Sept. 16, 1875	Main route; branch \$90, (118.)	5
r. p. o., 45 by 9, (average,) 1 l.; 18 by 9, 1 l.; fast mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9.	13	885 69½	755 00	66,404 16	56,609 90	Sept. 16, 1875	Pay to be fixed on new returns from July 23, 1876, date of discontinuance of fast mail. Average speed, 32 miles fast mail; 28 miles residue.	6
r. p. o., 36 by 9, 1 l.; 45 by 9, (average,) 1 l.; fast mail, 4 l.—60 by 9, 60 by 9, 45 by 9, 45 by 9.	17½*	817 50	615 00	82,567 50	62,115 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Average speed, 33 miles fast mail; 28 miles residue. Part; residue \$1,001, \$989.75, \$199.25, \$197.37½, (2, 3, 47, 48.)	7

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
8	Ohio...	9049	21045	Toledo, Elkhart.....	Lake Shore and Michigan Southern.	Miles. 133.6	Pounds. 37, 145	32, 28
9	Pa....	2401	8001	Philadelphia, Pitts- burgh.	Pennsylvania.....	353.6	29, 078	28
10	Md...	3503	.....	Baltimore, Washing- ton.	Baltimore and Ohio.....	40	26, 694	28
11	Md...	3514	.....	Bay View Junction, n. o., (Baltimore,) Washington.	Baltimore and Potomac .....	46.1	18, 754	26
12	Pa....	2401	.....	Philadelphia, Pitts- burgh.	Pennsylvania.....	353.6	20, 027	28
13	Ohio...	9036	21032	Columbus, Pittsburgh	Pittsburgh, Cincinnati and Saint Louis.	193	16, 420	31
14	Md...	3503	.....	Baltimore, Washing- ton.	Baltimore and Ohio.....	40	15, 362	28
15	Nebr.	34001	.....	Omaha, Ogden City ..	Union Pacific .....	1,032.40	15, 348	25
16	Md...	3514	.....	Baltimore, Washing- ton.	Baltimore and Potomac .....	42.6	12, 772	26
17	Md...	3504	10003	Baltimore, Grafton ...	Baltimore and Ohio .....	294	8, 360	24
18	Cal...	46001	.....	San Francisco, Ogden	Central Pacific .....	880.96	11, 434	21
19	Ohio...	9031	21027	Cincinnati, Xenia ....	Pittsburgh, Cincinnati and Saint Louis.	65.96	9, 196	28
20	N. Y..	1201	.....	New York, Dunkirk ..	Erie.....	459	6, 082	33
21	Ohio...	9016	21014	Columbus, Xenia .....	Columbus and Xenia .....	55	9, 096	28

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i> r. p. o. 45 by 9, (average) 1 l.; fast mail, 41—60 by 9, 60 by 9, 45 by 9, 45 by 9.	13	Dolla. 791 00	Dolla. 825 00	Dolla. 105,677 60	Dolla. 83,500 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Average speed, 32 miles fast mail; 28 miles residue.	8
r. p. o. 58.6 by 8.5, f. f. a. 1 l.; 46 by 8.5, f. f. c. 1 l.; tender, 99 by 7.9, 1 l.; r. a. apt., (average), 11.6 by 8, f. f. a. 1 l.	37½	598 00	417 00	211,432 80	147,451 20	Sept. 16, 1875	60 days, from Dec. 1, 1875.	9
r. p. o. 52.4 by 9.6, f. f. d. l.	54	551 00	375 00	22,040 00	15,000 00	July 1, 1873	To April 12, 1874. Weight for 30 days from Oct. 5, 1874, and 90 days on night-line r. p. o. from Dec. 31, 1875.	10
r. p. o. 46.10 by 9, f. f. d. l.; r. a. apt., 14.9 by —, f. f. a. 1 l.	39	431 00	327 00	19,869 10	13,930 20	June 4, 1875	90 days, from Oct. 1, 1875; 3.5 miles increase.	11
r. p. o. 46.5 by 8.9, f. f. c. a. 1 l.; r. a. apt., 10.11 by 8.7, f. f. a. 1 l.	36	417 00	438 00	147,451 20	154,876 80	July 1, 1874	90 days, from Oct. 1, 1874.	12
r. p. o. 50.5 by 9.2, f. f. a. 1 l.	20	383 00	230 00	73,726 00	44,390 00	Dec. 1, 1875	60 days, from Dec. 1, 1875.	13
r. p. o. 52.4 by 9.6, f. f. a. 1 l.	48	369 00	375 00	14,760 00	15,000 00	Apr. 19, 1874	To Nov. 30, (as modified, instead of June 3,) 1875. In Oct., 1874.	14
r. p. o. (easy) 50 by 9.9, f. f. c. a. 1 l.	7	340 00	315 00	351,016 00	325,206 00	Feb. 14, 1876	r. p. o., with platform, 54.5 by 9.9. See returns for 1874. In Feb., 1876.	15
r. p. o. 46.10 by 9, f. f. a. 1 l.; r. a. apt., 14.6 by 8.6, f. f. a. 1 l.	13	327 00	100 00	13,930 20	4,260 00	Apr. 19, 1874	Daily average of returns for 1873 and night r. p. o. line for 90 days, from Oct. 1, 1875, for adjustment from April 19, 1874, to June 3, 1875, during which period said night r. p. o. line was diverted from Washington branch Baltimore and Ohio Railroad to this route.	16
r. p. o. 52.4 by 9.7, f. f. c. d. l.; r. a. apt., 17 by 8.7, between Baltimore and Harper's Ferry, 96 m.	27½	322 00	360 00	94,668 00	106,206 00	Dec. 1, 1875	60 days, from Dec. 1, 1875. Part; residue \$282, (23.) 40 miles formerly at \$369.	17
r. p. o. 55.1½ by 8.9, f. f. c. a. 1 l.	7½	295 00	233 00	259,683 20	205,263 68	Feb. 14, 1876	In Feb. and March, 1876.	18
r. p. o. 50.5 by 9.2, f. f. a. 1 l.; r. a. apt., 19.7 by 8.6, f. f. a. 1 l.	20	292 00	210 00	19,260 32	13,851 60	Dec. 1, 1875	Part; residue \$50....	19
r. p. o. 50 by 10, f. f. c. d. l. to Honesdaleville, 332 m.; a. l. residue, 127 m.; r. a. apt., 15.11 by 10.4, f. f. a. 1 l.; 67 m.; 12.8 by 6.8, f. f. a. 1 l., 36 m.	17½	292 00	705 00	123,948 00	323,595 00	Sept. 16, 1875	127 miles at \$252. 60 days, from Dec. 1, 1875.	20
r. p. o. 50.5 by 9.2, f. f. a. 1 l.; r. a. apt., 19.7 by 8.6, f. f. a. 1 l.	13	291 00	210 00	16,005 00	11,550 00	Dec. 1, 1875	60 days, from Dec. 1, 1875.	21

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
22	Ind ...	22002	23002	Indianapolis, Terre Haute.	Terre Haute and Indianapolis.	73	9,069	30
23	Md ...	3504	10003	Grafton, Wheeling...	Baltimore and Ohio.....	99	8,360	24
24	Ill ...	23031	.....	East Saint Louis, Terre Haute.	Terre Haute and Indianapolis.	163.40	7,360	30
25	Ohio ..	9017	21015	Columbus, Indianapolis.	Columbus, Chicago and Indiana Central.	188	7,116	31
26	Ohio ..	9046	21042	Cleveland, Gallon .....	Cleveland, Columbus Cincinnati and Indianapolis.	80	7,748	36
27	W. Va.	12002	.....	Grafton, Parkersburg.	Baltimore and Ohio .....	104.58	6,506	29
28	Ohio ..	9001	21001	Bellaire, Newark .....	Central Ohio .....	104½	5,779	25
29	Ky....	20005	20005	Louisville, Nashville.	Louisville and Nashville .....	186.6	8,366	20½
30	Ohio ..	9041	21010	Chicago, O., Newark.	Baltimore and Ohio, (lessees Sandusky, Mansfield and Newark.)	88	5,463	30
31	Ohio ..	9032	21028	Cincinnati, Parkersburg.	Marietta and Cincinnati .....	195.15	7,096	30
32	Ohio ..	9046	21042	Gallon, Cincinnati .....	Cleveland, Columbus Cincinnati and Indianapolis.	165.25	7,748	36
33	Ind ...	22003	22003	Indianapolis, Cincinnati.	Indianapolis, Cincinnati and La Fayette.	113.50	6,415	28
34	Ind ...	22005	22005	Indianapolis, La Fayette.	.....do.....	65½	6,222	28
35	Ohio ..	9051	21047	Chicago, O., Chicago, Ill.	Baltimore and Ohio R. R. Co., (operating Baltimore, Pittsburgh and Chicago Railroad.)	271.53	4,717	35
36	Va....	4409	11008	Richmond, Petersburg.	Richmond and Petersburg .....	24.07	3,927	27
37	Ind ...	22028	22029	La Fayette, Kankakee.	Cincinnati, La Fayette and Chicago.	75.75	7,906	35
38	Ohio ..	9032	.....	Pittsburgh, Chicago..	Pittsburgh, Fort Wayne and Chicago.	469½	6,961	27
39	Va....	4410	11009	Petersburgh, Weldon	Petersburgh .....	65.51	3,342	20
40	Ind ...	22010	22010	Cincinnati, East Saint Louis.	Ohio and Mississippi .....	341	5,669	26.2



in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i> r.p.o. 50.6 by 9.3, f.f.c. a.l.; r.a. apt. 19.7 by 7.7, f.f. d.l.	12*	Dolla. 290 00	Dolla. 208 00	Dolla. 21,170 00	Dolla. 15,184 00	Dec. 1, 1875	60 days, from Dec. 1, 1875.	22
r.p.o. 52.4 by 9.7, f.f.c. a.l.; r.a. apt. 17 by 8.74, f.f.c. and m.c.s. a.l.; r.a. apt. 19 by 7.7, f.f. a.l.	27½	282 00	320 00	27,918 00	31,680 00	Dec. 1, 1875	60 days, from Dec. 1, 1875. Part; residue \$322, (17.)	23
r.p.o. 50.6 by 9.9, f.f.c. and m.c.s. a.l.; r.a. apt. 19 by 7.7, f.f. a.l.	19	272 00	204 00	44,988 80	33,741 60	Dec. 1, 1875	60 days, from Dec. 1, 1875.	24
r.p.o. 50.5 by 9.2, f.f. a.l.	20	266 00	166 00	50,008 00	31,208 00	Dec. 1, 1875	60 days, from Dec. 1, 1875.	25
r.p.o. 39.2 by 9.2, f.f. d.l.	19	260 60	262 00	20,848 00	20,960 00	July 1, 1876	Part; residue \$235.60 (32.) Under act of July 12, 1876.	26
r.p.o. 52.4 by 9.7, f.f.c. a.l.	19	258 00	330 00	26,981 64	34,511 40	Dec. 1, 1875	60 days, from Dec. 1, 1875.	27
r.p.o. 50 by 2, f.f. a.l.	20	249 00	267 00	26,113 88	28,001 62	Dec. 1, 1875	60 days, from Dec. 1, 1875. Part; residue \$95, (112.)	28
r.p.o. 45 by 9.7, f.f. a.l. to Bowling Green, 113.5 miles; r.a. apt. 14.9 by 9.7, f.f. 1½ l. to Bowling Green, 113.5 m. and 2½ l. road. 73.1 m.; addl. r.a. apt. 14 by 7.4 f.f. a.l. to Lebanon Junction, 30 m.	18½	247 80	247 50	44,046 48	43,990 50	July 1, 1876	Average speed, 73.1 miles formerly at \$217.50; 73.1 miles now at \$217.80. Under act of July 12, 1876.	29
r.p.o. 50 by 2, f.f. a.l.	20	245 00	152 00	21,560 00	13,376 00	Dec. 10, 1875	60 days, from Dec. 1, 1875. Part; residue \$75, (145.)	30
r.p.o. 52.4 by 9, f.f. a.l. apt. (no r.a.) 14 by 9, a.l.	14	243 40	373 00	47,499 51	72,790 95	July 1, 1876	Under act of July 12, 1876.	31
r.p.o. 39.2 by 9.2, f.f. a.l.	19	235 60	237 00	38,932 90	39,164 25	July 1, 1876	Part; residue \$260.60 (26.) Under act of July 12, 1876.	32
r.p.o. 50 by 9.5, f.f.c. a.l.; r.a. apt. 12 by 7.6, f.f.c. a.l.	18	235 30	268 00	26,706 55	30,418 00	July 1, 1876	Under act of July 12, 1876.	33
r.p.o. 50 by 9.5, f.f.c. a.l.; r.a. apt. 12 by 7.6, f.f. a.l.	22*	234 40	262 00	15,382 50	17,193 75	July 1, 1876	Under act of July 12, 1876.	34
r.p.o. 50 by 8, f.f. a.l.; r.a. apt. 20 by 2, f.f. a.l.	14	235 00	203 00	63,809 55	55,120 59	Dec. 10, 1875	60 days, from Dec. 10, 1875.	35
r.p.o. 42 by—, f.f. c. d.l.	13	232 00	213 00	5,734 24	5,368 50	July 1, 1875	\$150 m. m. 60 days, half from June 1, 1875, and residue from Jan. 24, 1876. 0.43 mile decrease.	36
r.p.o. 50 by—, f.f. c. a.l.; r.a. apt. 12 by 7.7, f.f. c. a.l.	13	224 50	262 00	17,005 87	19,846 50	July 1, 1876	Under act of July 12, 1876.	37
54.3 by 11.21 by 2.9, f.f. d.l. to Homewood, 35 m.; a.l. road.	25½	224 00	209 00	105,518 00	98,475 50	July 1, 1873 to Aug. 8, 1875	90 days, from Oct. 1, 1874. 35 miles at \$234; 35 miles formerly at \$219.	38
r.p.o. 42.4 by 8.10, f.f. c. d.l.	13	222 00	204 00	14,543 22	13,364 04	July 1, 1875	60 days, one-half from June 1, 1875, and residue from Jan. 24, 1876.	39
r.p.o. 50 by 10, 50 by 10, 50 by 10, 45 by 10, 41 by 10, f. a.l.	13½	215 00	254 00	73,315 00	88,424 00	July 1, 1876	72.40 miles formerly at \$279. Under act of July 12, 1876.	40

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-route<sup>a</sup>

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
41	Ky....	20008	20008	Bowling Green, Guthrie.	Louisville and Nashville .....	Miles. 51	Pounds. 5,410	24
42	Tenn...	19009	19009	Guthrie, Paris .....	.....do.....	82.5	5,030	24
43	Tenn...	19010	19010	Milan, Paris .....	.....do .....	43.5	4,969	25
44	Ohio ..	9002	.....	Pittsburgh, Chicago..	Pittsburgh, Fort Wayne and Chicago.	469.50	5,755	25
45	Ky....	20004	20004	Cincinnati, Louisville	Louisville, Cincinnati, and Lexington.	110½	8,362	27½
46	Ohio ..	9051	.....	Chicago, O., Chicago, Ill.	Baltimore and Ohio, (operating Baltimore, Pittsburgh and Chicago.)	271.53	2,801	35
47	N. Y ..	1241	.....	Toledo, Elkhart.....	Lake Shore and Michigan Southern.	143	2,215	32, 2½
48	N. Y ..	1241	.....	Elyria, Millbury.....	.....do.....	79.3	2,215	32, 2½
49	Ohio ..	9011	.....	Chicago, O., Newark.	Baltimore and Ohio, (lessees Sandusky, Mansfield and Newark.)	88	2,321	30
50	Ill.....	23010	.....	Galesburgh, Quincy..	Chicago, Burlington and Quincy.	100	3,172	25
51	Ohio ..	9002	21002	Pittsburgh, Chicago..	Pittsburgh, Fort Wayne and Chicago.	469½	4,619	27
52	Mo....	28011	.....	Sedalia, Denison .....	Missouri, Kansas and Texas...	447	2,809	22
53	Tenn...	19002	19002	Bristol, Chattanooga.	East Tennessee, Virginia and Georgia.	242.7	4,023	20
54	Ohio ..	9018	21016	Gallon, Indianapolis.	Cleveland, Columbus, Cincinnati and Indianapolis.	204	3,830	31
55	Ky....	20018	20018	Cincinnati Junction, Louisville and Nashville Junction.	Louisville, Cincinnati and Lexington.	4.13	4,785	12
56	Mo....	28014	.....	Hannibal, Sedalia....	Missouri, Kansas and Texas...	142.88	2,135	20
57	Ill.....	23028	.....	Terre Haute, East Saint Louis.	Indianapolis and Saint Louis.	189	2,223	30
58	N. Y ..	1222	.....	Troy, Saratoga Springs.	Delaware and Hudson Canal Company.	32.81	2,816	30
59	Ohio ..	9030	21026	Cincinnati, Hamilton.	Cincinnati, Hamilton and Dayton.	26.53	3,961	26
60	N. C. ...	13002	13002	Weldon, Wilmington.	Wilmington and Weldon .....	163.07	3,699	24
61	Ga ....	15003	15003	Atlanta, West Point.	Atlanta and West Point .....	86.68	2,404	22

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
r. p. o., 45 by 9.5, f. f., a. l.; apt. in b. c. (no r. a.) 14.9, by 9.7, f. f., a. l.	13	210 00	186 00	10,710 00	9,486 00	July 1, 1876	Under act of July 12, 1876.	41
r. p. o., 45 by 9.5, f. f., a. l.; apt. in b. c. (no r. a.) 14.9, by 9.7, f. f., a. l.	13	210 00	183 00	17,325 00	15,097 50	July 1, 1876	Under act of July 12, 1876.	42
r. p. o., 45 by 9.5, f. f., a. l.	17½	209 10	175 00	9,095 85	7,612 50	July 1, 1876	Part; residue \$135, (74.) Under act of July 12, 1876.	43
243 by 8.1½, 21 by 8.9, f. f., d. l. to Homewood, 35 m.; a. l. residue, \$4.50 miles.	22½	209 00	300 00	98,475 50	140,850 00	July 1, 1873	In Aug., 1875; additional "fast mail" from Sept. 12, 1875, 7 times per week. 35 miles, at \$219.	44
26 by 8, f. f., a. l., and b. c.	18	207 00	300 00	22,847 63	22,075 00	July 1, 1876	Under act of July 12, 1876.	45
r. p. o., 50 by 8, f. f., a. l.; r. a. apt., 20 by 8, f. f., a. l.	14	203 00	.....	.....	.....	Feb. 16, 1875	New. In June, 1875.	46
r. p. o., 38 by 9, 1 l., 36 by 9, 1 l.	17½	199 25	485 00	28,492 75	69,355 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Average speed, 32 miles fast mail, 28 miles residue. Part; residue \$1,001, \$989.75, \$817.50, \$197.37½, (2, 3, 7, 48.)	47
r. p. o., 38 by 9, (average,) 1 l.; 45 by 9, (average) ½ l.; 18 by 9, ½ l.	17½	197 37½	485 00	15,651 84	38,460 50	Sept. 16, 1875	60 days, from Dec. 1, 1875. Average speed, 32 miles fast mail, 28 miles residue. Part; residue \$1,001, \$989.75, \$817.50, \$199 25, (2, 3, 7, 47.)	48
r. p. o., 50 by 8, f. f., a. l.	20	195 00	152 00	17,160 00	13,376 00	Feb. 16, 1875	In June, 1875. Part; residue \$93, (114.)	49
r. p. o., 44.11 by 9.6, f. f. c. and m. c., a. l.	12	194 00	190 00	19,400 00	19,000 00	July 1, 1875	Ordered July, 1876 ..	50
243 by 11½, 21 by 8.9, f. f., d. l. to Homewood, 35 m.; a. l. residue.	29½	193 00	209 00	90,613 50	98,125 50	Dec. 1, 1875	66 days, from Dec. 1, 1875. 35 miles formerly at \$219.	51
r. p. o. (say,) 51.2 by 9.10, f. f., a. l.	7	190 00	223 00	84,830 00	99,681 00	July 1, 1875	In July, 1875, r. p. o. "over all" 57.7. See Oct. 73 returns.	52
r. p. o., 39.7 by 8.9½, f. f. c., a. l.	14	189 70	244 00	46,040 19	59,218 80	July 1, 1876	Main route; branch \$135, (78.) Under act of July 12, 1876.	53
r. p. o., 39.2 by 9.2, f. f. c., a. l.	15½	187 00	185 00	38,148 00	37,740 00	July 1, 1876	Under act of July 12, 1876.	54
In charge of conductor.	12	182 00	.....	.....	.....	July 1, 1874	New: ordered Sept., 1876.	55
r. p. o. (say,) 51.2 by 9.10, f. f., a. l.	7	180 00	215 00	25,718 40	30,719 20	July 1, 1875	In July, 1875, r. p. o. "over all," 57.7. See Oct., 1873, returns.	56
r. p. o., 40 by 9.6, f. f. c., a. l.	18	178 00	185 00	33,642 00	34,965 00	July 1, 1875	In April, 1875 .....	57
21.9 by 7, f. f., a. l.	21½	163 00	150 00	5,348 03	4,921 50	July 1, 1873	60 days, in May and August, 1875. Ordered Nov., 1875.	58
19 by 7.3, 8 by 6.8, f. f., d. l.	59½	162 00	187 50	4,297 86	4,974 37	July 1, 1876	Part; residue \$135, (75.) Under act of July 12, 1876.	59
21.8 by 8.7, f. f., a. l.	13	160 20	172 00	26,123 81	22,036 00	July 1, 1876	Main route; branch \$45. .07 m. increase. Under act of July 12, 1876.	60
17 by 8.3, f. f., a. l.	14	156 00	125 00	13,524 08	10,786 25	Jan. 1, 1876	In Jan., 1876. .39 m. increase.	61

F. Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
62	N. Y ..	1221	.....	Eagle Bridge, Rutland	Delaware and Hudson Canal Company.	Miles. 69½	Pounds 2,233	30
63	Ala ....	17001	17001	Montgomery, West Point.	Western, of Alabama .....	88.5	2,904	23
64	N. Y ..	1294	.....	Albany, Canada Line.	Delaware and Hudson Canal Company.	189.93	2,123	30
65	Miss ..	18001	18001	Canton, Cairo .....	New Orleans, Saint Louis and Chicago.	342.98	2,819	20
66	Pa ....	2429	.....	New Castle, Homewood.	Pittsburgh, Fort Wayne and Chicago.	15	2,140	23
67	S. C ....	14002	14002	Florence, Wilmington	Wilmington, Columbia and Augusta.	109.70	3,106	25
68	Ga ....	6001	15004	Augusta, Atlanta ....	Georgia .....	171.62	1,943	25
69	N. J. ....	2101	7001	New York, Easton...	Central, of New Jersey.....	74	2,613	27
70	Ga ....	15004	15004	Augusta, Atlanta....	Georgia .....	171.62	1,855	25
71	N. Y ..	1211	.....	Albany, Troy .....	New York Central and Hudson River.	6	1,801	30
72	Ohio ..	9007	21006	Cleveland, Wellsville.	Cleveland and Pittsburgh .....	102.36	2,696	30
73	Tenn..	19004	19004	Nashville, Chattanooga.	Nashville and Chattanooga....	153	2,534	25
74	Tenn..	19010	19010	Memphis, Milan ....	Louisville and Nashville.....	89	2,416	25
75	Ohio ..	9030	21026	Hamilton, Dayton....	Cincinnati, Hamilton and Dayton.	33.92	2,391	26
76	S. C ....	14005	14005	Charleston, Florence.	Northeastern.....	103	2,366	19½
77	Ala ....	17013	17013	Mobile, New Orleans	New Orleans, Mobile and Texas	140	2,148	26
78	Tenn..	19002	19002	Cleveland, Dalton....	East Tennessee, Virginia and Georgia.	22.5	2,017	20
79	N. Y ..	1208	.....	Buffalo, Hornellsville	Erie .....	91	1,670	30
80	N. Y ..	1220	.....	Saratoga Springs, Castleton.	Delaware and Hudson Canal Company.	54	1,644	30
81	N. J ..	2106	7013	New York, Washington.	Morris and Essex.....	73	1,636	25
82	Pa ....	2445	.....	Miles Grove, New Castle.	Erie and Pittsburgh.....	83	1,606	20
83	Ind....	29007	29007	New Albany, Indianapolis.	Jeffersonville, Madison and Indianapolis.	114	1,948	27
84	Tex ....	8503	31003	Houston, Denison City.	Houston and Texas Central....	337.55	2,069	20
85	N. Y ..	1255	.....	Canandaigua, Elmira..	Northern Central.....	68.5	1,332	23
86	Ga ....	6008	15009	Savannah, Live Oak..	Atlantic and Gulf .....	180.47	1,519	19

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i> 21.9 by 7, f. f., a. l., to Castleton, 51 miles; d. l. residue, 11½ miles.	20½*	Dolla. 133 00	Dolla. 150 00	Dolla. 9, 677 50	Dolla. 9, 375 00	July 1, 1873	60 days, in May and August, 1875. 11½ miles at \$163. Or- dered Nov., 1875.	62
16 by 8.6, f. f., a. l.	14	153 00	105 00	13, 540 50	9, 292 50	Jan. 1, 1876	In January, 1876 ....	63
21.6 by 6.9, f. f., a. l.	17½*	152 00	107 00	28, 869 36	19, 038 51	Feb. 1, 1876	Main route; br'chs \$100, \$75, (106, 142., 12 m. increase.	64
r. p. o., (average,) 34.9 by 9.7, f. f., a. l.	7	150 70	180 00	51, 687 08	61, 736 40	July 1, 1876	Under act of July 12, 1876.	65
12 by 8, f. f., a. l.	12	150 00	100 00	2, 250 00	1, 500 00	Oct. 12, 1874	In August, 1875; or- dered Oct. 1875.	66
22.7 by 8.9, f. f., a. l.	13	148 50	155 00	16, 290 45	17, 003 50	July 1, 1876	Part; residue \$81, (130.) Under act of July 12, 1876.	67
24.6 by 8.6, f. f., a. l.	13	147 00	125 00	25, 228 14	21, 457 50	July 1, 1875	In October, 1875; .04 m. decrease. Under contract to June 30, 1875; ordered December, 1875.	68
14 by 7, d. l. ....	49*	144 00	300 00	10, 656 00	22, 200 00	July 1, 1876	Under act of July 12, 1876.	69
r. p. o., 25.4 by 8.8, f. f., a. l.	12	142 80	147 00	24, 507 33	25, 228 14	July 1, 1876	Under act of July 12, 1876.	70
.....	27	149 00	597 00	840 00	3, 582 00	Sept. 16, 1875	60 days, from Dec. 1, 1875. Part; residue \$985, (4.)	71
13 by 9, f. f., a. l. .	15½*	139 50	152 00	14, 279 22	15, 558 72	July 1, 1876	Under act of July 12, 1876.	72
12.6 by 8.8, f. f., a. l.	15½*	135 00	145 00	20, 655 00	24, 525 00	July 1, 1876	39 miles formerly at \$205. Under act of July 12, 1876.	73
15 by 8, f. f., a. l. .	20	135 00	145 00	12, 015 00	12, 905 00	July 1, 1876	Part; residue \$209.10, (43.) Under act of July 12, 1876.	74
19 by 7.3, 8 by 6.8, f. f., a. l.	27*	135 00	150 00	4, 579 20	5, 088 00	July 1, 1876	Part; residue \$162, (59.) Under act of July 12, 1876.	75
12 by 9, f. f., a. l. .	13	135 00	116 00	13, 905 00	11, 948 00	July 1, 1876	Under act of July 12, 1876.	76
17.6 by 7.3, f. f., a. l.	14	135 00	130 00	18, 900 00	18, 200 00	July 1, 1876	Under act of July 12, 1876.	77
22 by 8.4, f. f., a. l. .	14	135 00	100 00	3, 847 50	2, 850 00	July 1, 1876	Branch; main route \$189.70, (53.) Un- der act of July 12, 1876.	78
14 by 9.2, 12.6 by 9.10, f. f., a. l.	22½*	133 00	362 50	12, 103 00	32, 987 50	Sept. 16, 1875	60 days, from Dec. 1, 1875.	79
21.9 by 7, f. f., a. l. .	16½*	132 00	150 00	7, 128 00	8, 100 00	July 1, 1873	60 days, in May and Aug., 1875. Or- dered Nov., 1875.	80
12 by 7.3, (63 miles), 11.7 by 7.7, (73 miles), 19.9 by 7. 6, (29 miles.) f. f., d. l. to Dover, 44 miles; t. l. thence to Hackett- town, 19 miles; d. l. residue, 10 miles.	13½*	131 00	100 00	9, 753 00	6, 800 00	July 1, 1873	In July, 1874. Re- ported Nov., 1875. 10 m., formerly at \$50. 19 m. now at \$141. Part; resi- due \$60, (192.)	81
12 by 9, f. f., a. l. .	12	130 00	80 00	10, 790 00	6, 640 00	Oct. 12, 1874	In Aug., 1875. Or- dered Oct., 1875.	82
13 by 7, f. f., a. l. .	19	126 00	134 00	14, 364 00	15, 276 00	July 1, 1876	Under act of July 12, 1876.	83
14 by 7.3, f. f., a. l.	6	125 00	153 00	42, 193 75	52, 645 15	July 1, 1875	In March, 1875 .....	84
15 by 8.4, (aver- age), 1½ l.	18½*	121 00	150 00	8, 288 50	10, 275 00	July 1, 1873	In Nov., 1875. Or- dered Feb., 1876.	85
16.6 by 9.3, f. f., a. l.	7	120 00	100 00	21, 656 40	18, 075 00	July 1, 1873	60 days, in Jan. and Oct., 1875. Ordered Dec., 1875. 28 m. decrease. Main route; branch \$58, (198.)	86

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
87	N. C. . .	13004	13004	Greenboro', Charlotte	Richmond and Danville . . . . .	93	2,433	21½
88	Ga. . . .	15009	15009	Savannah, Live Oak..	Atlantic and Gulf . . . . .	179.90	1,701	20
89	S. C. . .	14004	14004	Charleston, Savannah	Savannah and Charleston . . . . .	107.63	1,880	17
90	Ohio . .	9003	21003	Rochester, Bellaire...	Cleveland and Pittsburgh . . . . .	68.75	1,717	30
91	Ohio . .	9003	21003	Pittsburgh, Rochester	.....do.....	25.75	1,717	30
92	Tenn..	19006	19006	Nashville, Columbia .	Louisville and Nashville . . . . .	47	1,670	24
93	Ind . . .	22018	22019	Jeffersonville, North Vernon.	Ohio and Mississippi . . . . .	53.50	1,661	24½
94	S. C. . .	5607	14005	Charleston, Florence.	Northeastern.....	103	1,396	19
95	Ohio . .	9027	21023	Dayton, Toledo . . . . .	Dayton and Michigan . . . . .	142.96	1,743	23
96	Ala. . . .	17012	17012	Mobile, Montgomery.	Mobile and Montgomery . . . . .	179	2,598	24
97	N. J. . .	2122	7022	New York, Denville .	Delaware, Lackawanna and Western.	35.93	1,058	26½
98	Ga. . . .	6011	15012	Macon, Atlanta.....	Macon and Western.....	103.52	1,235	20
99	N. Y. . .	1224	.....	Albany, Albany Junction.	Delaware and Hudson Canal Company.	12	1,148	30
100	Ky . . .	20002	20002	Covington, Lexington	Kentucky Central... . . . .	99	1,496	22
101	N. C. . .	13007	13007	Charlotte, Augusta ..	Charlotte, Columbia and Augusta.	195.75	1,363	20
102	Mich. . .	24035	.....	Trenton Crossing, Detroit.	Toledo, Canada Southern and Detroit.	17.30	859	28
103	N. Y. . .	1245	.....	Albany, Binghamton	Delaware and Hudson Canal Company.	142	1,032	30
104	Tenn. . .	19006	19006	Columbia, Decatur...	Louisville and Nashville . . . . .	75½	1,670	24
105	Pa. . . .	2429	.....	Newcastle, Home-wood.	Pittsburgh, Fort Wayne and Chicago.	15	2,140	23
106	N. Y. . .	1224	.....	Whitehall, Castleton.	Delaware and Hudson Canal Company.	16	1,255	30
107	Mo . . .	28030	.....	Saint Joseph, Atchison.	Hannibal and Saint Joseph....	22.06	1,115	20
108	Ala . . .	17005	17005	Memphis, Stevenson	Memphis and Charleston . . . . .	271.5	1,207	23
109	Ill . . .	11913	23036	Aurora, Forreston . .	Chicago and Iowa . . . . .	81.64	972	21
110	Iowa. . .	27011	.....	Viele Junction, Burlington.	Chicago, Burlington and Quincy	25.75	738	21
111	Ind . . .	22012	22012	Evansville, Terre Haute.	Evansville and Crawfordville	110	1,188	28
112	Ohio..	9001	21001	Newark, Columbus ..	Central Ohio . . . . .	33	1,061	25

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
18 by 9, f. f., a. l. . .	7	118 80	164 00	11, 048 40	15, 252 00	July 1, 1876	Part; residue \$67.50, (161.) Under act of July 12, 1876.	87
16.8 by 9.3, f. f., a. l	13	118 80	120 00	21, 288 96	21, 656 40	July 1, 1876	Main route; branch \$45, (295.) 1.27 m. decrease. Under act of July 12, 1876.	88
9 by 9, f. f., a. l. . . .	13	117 00	111 00	12, 592 71	11, 544 00	July 1, 1876	3.63 m. increase. Under act of July 12, 1876.	89
13 by 9, f. f., a. l. . .	18	117 00	100 00	8, 043 75	6, 875 00	July 1, 1876	Part; residue, (extension,) \$117, (91.) Under act of July 12, 1876.	90
13 by 9, f. f., a. l. . .	18	117 00	-----	-----	-----	July 1, 1876	New, (extension;) residue \$117, (90.) Under act of July 12, 1876.	91
14.9 by 9, f. f. . . . .	14	117 00	88 00	5, 489 00	4, 136 00	July 1, 1876	Part; residue \$100.80, (104.) Under act of July 12, 1876.	92
13 by 8.7, f. f., a. l .	13	117 00	175 00	6, 259 50	9, 362 50	July 1, 1876	Under act of July 12, 1876.	93
11 by 8.4, f. f., a. l .	13	116 00	125 00	11, 948 00	13, 000 00	July 1, 1875	In Oct., 1875. 1 mile decrease. Under contract to June 30, 1875. Ordered Nov., 1875.	94
8 by 6.8, 9 by 7.3, f. f., a. l .	16½*	115 30	150 00	16, 469 00	21, 444 00	July 1, 1876	Under act of July 12, 1876.	95
18 by 9, f. f., a. l .	14	113 04	150 00	20, 234 16	26, 850 00	July 1, 1876	Under act of July 12, 1876.	96
6.8 by 6.8, 6.6 by 5.3, 19.9 by 7.6, f. f., t. l .	18	112 00	50 00	4, 024 16	1, 796 50	July 1, 1873	In July, 1874. Reported Nov., 1875.	97
11.7 by 6.7, f. f., a. l	13	110 00	100 00	11, 387 20	10, 352 00	July 1, 1875	In Nov., 1875. Ordered Feb., 1876.	98
No r. a . . . . .	18	107 00	85 73	1, 284 00	1, 028 76	July 1, 1873	60 days, in May and Aug., 1875. Ordered Nov., 1875.	99
12 by 6.6, fixtures, a. l .	12	106 20	109 00	10, 513 80	10, 791 00	July 1, 1876	Part; residue \$61.20, (185.) Under act of July 12, 1876.	100
19 by 8, fixtures, a. l .	10½*	103 50	125 00	20, 260 13	24, 625 00	July 1, 1876	1.25 miles decrease. Under act of July 12, 1876.	101
16 by 9.3, 10.9 by 9.3, f. f., d. l .	19	102 00	86 00	1, 764 60	1, 487 80	July 1, 1875	Part; residue \$92, (115.)	102
17.4 by 9.10, f. f., a. l .	16½*	101 00	100 00	14, 342 00	14, 200 00	Oct. 1, 1875	60 days, in May and Aug., 1875.	103
14.9 by 9, f. f. . . . .	7	100 80	88 00	7, 593 60	6, 629 34	July 1, 1876	Part; residue \$117, (92.) Under act of July 12, 1876.	104
18 by 9, f. f., a. l. . .	6	100 00	50 00	1, 500 00	750 00	July 1, 1873	In Aug., 1875. Ordered Oct., 1875.	105
r. a. in b. c., a. l. . .	6	100 00	132 00	1, 600 00	2, 112 00	Feb. 1, 1876	Branch; main route \$152, (64.)	106
13 by 7, f. f., a. l. . .	13	100 00	-----	-----	-----	Dec. 20, 1875	New. In May and June, 1876.	107
24 by 9, f. f., a. l. . .	14	99 00	160 00	26, 878 50	43, 440 00	July 1, 1876	Main route; branch \$45, (306.) Under act of July 12, 1876.	108
38 by 24, f. f. c., a. l	12	98 00	40 00	8, 000 72	3, 265 60	July 1, 1873	60 days, in March, 1875 and January, 1876. Ordered April, 1876.	109
15.3 by 8.9, f. f., a. l . Lap. 12.6 by 7.7, fixtures, a. l .	12	96 00	80 00	2, 472 00	2, 060 00	July 1, 1875	Part; residue \$78, (134.) Lap 6 trips.	110
12.6 by 8, f. f., a. l .	12	95 40	100 00	10, 494 00	11, 000 00	July 1, 1876	Under act of July 12, 1876.	111
In b. c.; no r. a. . . .	20	95 00	267 00	3, 135 00	8, 811 00	Dec. 1, 1875	60 days, from Dec. 1, 1875. Part; residue \$249, (28.)	112

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						<i>Miles.</i>	<i>Pounds.</i>	
113	Ohio..	9006	21005	Cleveland, Leavittsburgh.	Atlantic and Great Western ..	49.75	1,108	25
114	Ohio..	9011	.....	Sandusky, Chicago, O.	Baltimore & Ohio, (lessees Sandusky, Mansfield & Newark.)	28	860	30
115	Mich.	24035	.....	Toledo, Trenton Crossing.	Toledo, Canada Southern and Detroit.	39.07	859	28
116	Ohio..	9015	21013	Columbus, Delaware.	Cleveland, Columbus, Cincinnati and Indianapolis.	24.75	1,453	30
117	Tex ..	8505	31004	Hempstead, Austin ..	Houston and Texas Central ...	118.7	1,094	20
118	N. J ..	2103	.....	Frankford Junction, Kensington Station.	Pennsylvania.....	2.95	964	27½
119	Me ...	244	.....	Bangor, Bucksport...	Consolidated European and North American.	19.35	582	22
120	Ohio..	9038	21034	Salamanca, Dayton ..	Atlantic and Great Western ..	389.55	969	27
121	Wis ..	25014	.....	Elroy, Saint Paul ....	West Wisconsin.....	198.4	768	23
122	Ohio..	9013	21012	Springfield, Sandusky	Cincinnati, Sandusky and Cleveland.	131.35	751	30
123	Ga....	15012	15012	Macon, Atlanta .....	Central Railroad and Banking Company.	103.52	957	20
124	Ark ..	29005	.....	Argenta, Altus .....	Little Rock and Fort Smith ...	120	899	12
125	Ill ...	23032	.....	Saint Louis, Evansville.	Saint Louis and Southeastern..	164.75	694	23
126	Ohio..	9020	21018	Portsmouth, Reed's Mills.	Marietta and Cincinnati.....	56	847	25
127	Miss..	7004	19004	Mobile, Columbus ...	Mobile and Ohio.....	472.7	659	24
128	Ga....	15001	15001	Atlanta, Charlotte. ..	Atlanta and Richmond Air Line.	266.50	1,045	24
129	Ohio..	9029	21025	Hamilton, Richmond.	Cincinnati, Richmond and Chicago.	45.1	887	25
130	S. C. ...	14002	14002	Columbia, Florence ..	Wilmington, Columbia and Augusta.	82.06	869	25
131	Nev ..	16419	45001	Reno, Virginia City ..	Virginia and Truckee.....	51.75	786	16
132	Fla ...	16002	16002	Jacksonville, Chattahoochee River.	Jacksonville, Pensacola and Mobile.	213.52	616	18
133	Ky ...	20003	20003	La Grange, Lexington.	Louisville, Cincinnati and Lexington.	67	822	20
134	Iowa..	27011	.....	Keokuk, Vile Junction.	Chicago, Burlington & Quincy.	17	574	21
135	Tenn..	19007	19007	Nashville, Hickman ..	Nashville and Chattanooga....	170.82	733	20
136	N. J ..	2111	7019	Glassborough, Millville.	West Jersey .....	22	724	21
137	Kans ..	33013	.....	Topeka, Kansas City.	Atchison, Topeka and Santa Fé.	49.84	708	22
138	Tex...	8577a	31005	Bremond, Waco.....	Houston and Texas Central ...	44.56	634	20
139	Cal ...	46011	.....	San Francisco, Lakeville.	San Francisco and North Pacific.	34	632	25



*in States in which the contract-term expired June 30, 1876, &c.—Continued.*

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i> 14.4 by 7.10, f. f., a. l.	24	Dolls. 94 50	Dolls. 100 00	Dolls. 4,701 38	Dolls. 4,975 00	July 1, 1876	Part; residue \$61.20, (186.) Under act of July 12, 1876.	113
16.6 by 6.8, f. f., a. l.	18	93 00	152 00	2,604 00	4,256 00	Feb. 16, 1875	In June, 1875. Part; residue \$193, (49.)	114
16.9 by 9.3, 10.9 by 9.3, f. f., a. l.	13	92 00	86 00	3,594 44	3,360 00	July 1, 1875	Part; residue \$102, (102.) Ordered October, 1875.	115
11 by 9.2, f. f., a. l.	6	90 00	120 00	2,227 50	2,970 00	July 1, 1876	Under act of July 12, 1876.	116
14 by 7.3, f. f., a. l.	6	90 00	100 00	10,683 00	11,870 00	July 1, 1875	In March, 1875. Ordered April, 1876.	117
13 by 6.24, a. l. ....	18	90 00	88 00	265 50	259 60	Sept. 16, 1875	60 days, from Dec. 1, 1875. Branch; main route \$915, (5.)	118
9.6 by 7.6, f. f., d. l.	12	89 00	.....	.....	.....	Feb. 1, 1875	New. In Sept., 1875. Ordered Oct., 1875.	119
14.4 by 7.10, f. f., a. l.	16*	88 20	90 00	34,358 31	35,059 50	July 1, 1876	Under act of July 12, 1876.	120
40 by 9, f. f., a. l. ....	6	88 00	100 00	17,459 20	19,840 00	July 1, 1875	In Sept., 1875. Main route; branch \$30. Ordered Dec., 1875.	121
13.6 by 9, f. f., a. l., and m. c.	13	87 50	100 00	11,493 12	13,135 00	Jan. 1, 1875	In April, 1875. Ordered Feb., 1876.	122
17.7 by 6.7, f. f., a. l.	13	87 30	110 00	9,037 30	11,387 20	July 1, 1876	Under act of July 12, 1876. 39 days, 9 from March 15 and 30 from May 15, 1876.	123
11 by 6, f. f., a. l. ....	6	85 00	.....	.....	.....	Oct. 1, 1875	In Jan., 1876. New. Ordered Apr., 1876.	124
12 by 6.6, f. f., a. l.	12	84 00	110 00	13,839 00	18,122 50	July 1, 1875	Main route; branch 45, (308.) In Mar., 1875; reported October, 1875.	125
14.6 by 9.6, f. f., a. l.	12	82 80	158 00	4,636 80	8,848 00	July 1, 1876	Under act of July 12, 1876.	126
22 by 9, f. f., a. l. ....	7	82 00	125 00	38,761 40	59,087 50	July 1, 1873	In Oct., 1875. Main route; branch \$50, (249.) Ordered Nov., 1875.	127
19.11 by 8.114, f. f., a. l.	7	81 00	100 00	21,586 50	26,650 00	July 1, 1876	Under act of July 12, 1876.	128
12 by 9, f. f., a. l. ....	12	81 00	118 00	3,653 10	5,321 80	July 1, 1876	Under act of July 12, 1876.	129
22.7 by 8.9, f. f., a. l.	7	81 00	100 00	6,648 48	8,208 00	July 1, 1876	Part; residue \$148.50, (67.) Under act of July 12, 1876.	130
13.10 by 8, a. l. ....	7	80 00	72 29	4,140 00	3,741 00	July 1, 1874	In March, 1876. Ordered May, 1876.	131
16 by 8, (82 miles.) 10 by 7, (131.75 miles.) f. f., a. l.	114*	80 00	90 00	17,081 60	19,396 80	July 1, 1875	60 days, half from Nov. 15, 1875, and residue from January 1, 1876. Main route; branch \$20, (345.) 2 miles decrease.	132
8.6 by 6.1, f. f., a. l.	12	79 30	92 00	5,246 10	6,164 00	July 1, 1876	Under act of July 12, 1876.	133
15.3 by 8.9, f. f., a. l.	12	78 00	80 00	1,326 00	1,360 00	July 1, 1875	Part; residue lap, (110.)	134
12.6 by 8.8, f. f., a. l.	124*	77 40	78 00	13,221 47	13,323 96	July 1, 1876	Under act of July 12, 1876.	135
13 by 8.3, f. f., a. l.	12	76 50	100 00	1,683 00	2,200 00	July 1, 1876	In March, 1876. Under act July 12, 1876.	136
13 by 8.6, (average) f. f., a. l.	7	75 00	.....	.....	.....	Jan. 1, 1875	In Jan., 1876. New; ordered April, 1876.	137
14 by 7.3, f. f., a. l.	6	75 00	.....	.....	.....	July 1, 1875	In Mar., 1875. New; ordered Mar., 1876.	138
12 by 9, a. l. ....	7	75 00	.....	.....	.....	July 1, 1874	New; in June, 1876. Ordered Sept., 1876. Part; residue \$75, (140.)	139

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
140	Cal ...	46011	.....	Lakeville, Cloverdale.	San Francisco and North Pacific.	56	632	25
141	Kans	33009	.....	Atchison, Lincoln....	Atchison and Nebraska.....	152.28	558	23
142	N. Y. ...	1924	.....	Troy, Albany Junction.	Delaware and Hudson Canal Co.	6	547	30
143	Ala ...	6610	17010	Selma, Dalton.....	Selma, Rome and Dalton.....	237.5	545	20
144	N. Y. ...	1288	.....	Carthage, Theresa Junction.	Utica and Black River .....	20.50	589	20
145	Ohio ...	9011	21010	Sandusky, Chicago, O.	Baltimore and Ohio, (lessces Sandusky, Mansfield and Newark.)	28	513	30
146	Ind...	22004	22004	Indianapolis, Peru ...	Indianapolis, Peru and Chicago.	78	609	21
147	Ind...	22009	22009	Richmond, Chicago ..	Pittsburgh, Cincinnati and Saint Louis.	225.5	661	25
148	N. Y. ...	1804	.....	Saratoga Springs, North Creek.	Adirondack .....	57.96	578	20
149	Tenn...	19008	19008	Nashville, Guthrie...	Saint Louis and Southeastern ..	48	589	23
150	Utah ...	41003	.....	Ogden, Franklin .....	Utah Northern .....	79.94	645	14
151	Ill ...	23005	.....	Sterling, East Saint Louis.	Saint Louis, Rock Island and Chicago.	291.36	450	22
152	Vt ...	528	.....	Wells River, Montpelier.	Montpelier and Wells River...	38.62	443	21
153	N. Y. ...	1234	.....	Hicksville, Port Jefferson.	Long Island.....	36.50	390	23
154	Ky ...	20007	20007	Lebanon Junction, Richmond Junction.	Louisville and Nashville .....	76.4	742	20
155	Ga....	15010	15010	Savannah, Macon ....	Central Railroad and Banking Co.	192½	597	20
156	S. C. ...	14003	14003	Branchville, Charleston.	South Carolina.....	62.25	563	18
157	Mich...	24008	.....	Jackson, Fort Wayne.	Fort Wayne, Jackson and Saginaw.	96.22	436	22
158	N. J. ...	2258	7003	Elizabethport, Sea Plain.	Central, of New Jersey.....	47.9	422	27
159	Ind...	22013	22014	State Line, Logansport.	Pittsburgh, Cincinnati and Saint Louis.	61	710	22
160	Ky ...	20011	20011	Louisville, Elizabethtown, Paducah.	Louisville, Paducah and Southwestern.	232.19	641	20
161	N. C. ...	13004	13004	Goldsborough, Greensborough.	Richmond and Danville .....	130.35	594	21
162	Ga....	15005	15005	Millen, Augusta .....	Central Railroad and Banking Co.	53½	518	15

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
12 by 9, a. l. ....	7	75 00	50 00	4,200 00	2,800 00	July 1, 1874	In June, 1876. Part; residue new, \$75 (139.) Ordered Sept., 1876.	140
18.2 by 8.10, 12 by 7. f. f. c., a. l.	6	75 00	60 00	11,421 00	9,136 80	June 1, 1876	In June, 1876. Ordered Aug., 1876.	141
No r. a. ....	24	75 00	150 00	450 00	900 00	Feb. 1, 1876	Branch: main route \$152, (64.)	142
14 by 7.6, f. f., a. l.	7	75 00	100 00	17,812 50	23,750 00	July 1, 1875	In Oct., 1875. Under contract to June 30, 1875. Ordered Jan., 1876.	143
9 by 9, f. f., a. l. ....	12	75 00	.....	.....	.....	Mar. 15, 1875	Part; residue \$50 (262); branch \$57 (205.) In Mar., 1876. New; ordered May, 1876.	144
16.6 by 6.8, f. f., a. l.	18*	75 00	152 00	2,100 00	4,256 00	Dec. 10, 1875	60 days, from Dec. 15, 1875. Part; residue \$245, (30.) \$600 for side service. Under act of July 12, 1876.	145
12 by 7.1, f. f., a. l.	20½*	73 80	100 00	6,356 40	8,400 00	July 1, 1876	Under act of July 12, 1876.	146
11 by 8.9, f. f., a. l.	13	73 80	75 00	16,641 90	16,912 50	July 1, 1876	Under act of July 12, 1876.	147
12.6 by 5.10, f. f., a. l.	6	72 00	.....	.....	.....	July 15, 1875	New; ordered July, 1876.	148
11.6 by 7.6, f. f., a. l.	13	71 10	112 00	3,412 80	5,376 00	July 1, 1876	Under act of July 12, 1876. To be consolidated with Ill. route 23032.	149
Freight-car, 24 by 8, f. f., a. l.	7	70 00	50 00	5,595 80	4,025 00	Aug. 2, 1875	In Aug., 1875. .56 m. decrease.	150
12 by 9.4, f. f., a. l.	13½*	70 00	64 00	20,395 20	18,647 04	Mar. 15, 1876	In Mar., 1876 .....	151
12 by 6.10, f. f., a. l.	6	70 00	45 00	2,703 40	1,737 90	Jan. 1, 1876	In Jan., 1876 .....	152
13 by 8, f. f., d. l. to Northport, 16½ m.; a. l. residue, 20 m.	12	70 00	.....	.....	.....	Aug. 1, 1875	In Oct., 1875. 90 miles at \$60. New; ordered Mar., 1876.	153
14 by 7.4, f. f., a. l.	6	69 30	54 00	5,294 52	4,125 60	July 1, 1876	Main route, part; residue \$40.50 (318.) branch \$54.90, (214.) Under act of July 12, 1876.	154
8.9 by 7, f. f., a. l. ....	14	69 30	80 00	13,314 25	15,370 00	July 1, 1876	39 days, 8 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	155
10 by 8, f. f., a. l. ....	20	68 40	80 00	4,257 90	5,080 00	July 1, 1876	Branch: main route \$63, (177.) 1.25 miles decrease. Under act of July 12, 1876.	156
10.6 by 9, f. f., a. l.	10½*	68 00	51 00	6,583 76	4,937 82	Apr. 18, 1876	In Mar., 1876 .....	157
12 by 7, fixtures, a. l.	12	68 00	.....	.....	.....	Nov. 15, 1875	New .....	158
18.4 by 8.7, f. f., a. l.	6	67 50	75 00	4,117 50	4,575 00	July 1, 1876	Under act of July 12, 1876.	159
10.3 by 8, (average,) a. l.	6	67 50	64 00	15,672 83	14,860 16	July 1, 1876	Under act of July 12, 1876.	160
19 by 8, f. f., a. l. ....	7	67 50	75 00	8,798 62	9,776 25	July 1, 1876	Part; residue \$118.00, (87.) Under act of July 12, 1876.	161
8.2 by 7, f. f., a. l. ....	14	67 50	79 00	3,585 94	4,196 87	July 1, 1876	40 days, 10 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	162

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
163	Ohio...	9045	21041	Lorain, Uhrichsville	Cleveland, Tuscarawas Valley and Wheeling, (late Lake Shore and Tuscarawas Valley.)	102.45	518	25
164	Ga....	15011	15011	Macon, Columbus....	Southwestern .....	100.94	517	20
165	Ky...	20010	20010	Evansville, Guthrie..	Saint Louis and Southeastern ..	110.66	511	23
166	Md...	3507	10006	Baltimore, Williamsport.	Western Maryland .....	91.62	509	25
167	Ind...	22008	22008	New Albany, Michigan City.	Louisville, New Albany and Chicago.	288	506	20
168	Ohio...	9047	21043	Mansfield, Toledo....	Pennsylvania .....	88.10	492	22
169	Miss...	18002	18002	Memphis, Grenada...	Mississippi and Tennessee ....	101.7	479	20
170	Ga...	6012	15013	Macon, Brunswick...	Macon and Brunswick .....	188	387	24
171	Miss...	7002	18002	Memphis, Grenada...	Mississippi and Tennessee ....	101.7	384	20
172	Miss...	18003	18003	Vicksburgh, Jackson.	Vicksburgh and Meridian .....	45.5	1,023	18
173	Ga....	15016	15016	Macon, Fort Valley..	Southwestern .....	29.50	475	17½
174	Ga...	15016	15016	Fort Valley, Eufaula.	Southwestern .....	115.34	475	17½
175	Ohio...	9053	21049	Marietta, Parkersburgh.	Marietta and Cincinnati .....	15.87	466	25
176	Ga....	6006	15007	Union Point, Athens	Georgia .....	39.92	375	25
177	S. C...	14003	14003	Kingsville, Augusta...	South Carolina .....	118	464	17
178	S. C...	14003	14003	Kingsville, Columbia.	..... do .....	25.7	451	18
179	N. Y...	1390	.....	Buffalo, Jamestown..	Buffalo and Jamestown .....	71.09	365	25
180	Utah...	41002	.....	Salt Lake City, Provo City.	Utah Southern .....	49	361	15

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
		Dolls.	Dolls.	Dolls.	Dolls.			
<i>Feet and inches.</i> 14.7 by 9, f. f., a. l.	6½*	67 50	50 00	6, 915 38	5, 122 50	July 1, 1876	Under act of July 12, 1876.	163
12.8 by 6.3, f. f., a. l.	6	67 50	100 00	6, 813 45	10, 094 00	July 1, 1876	45 days, 15 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	164
11.6 by 7.6, f. f., a. l.	13	67 50	108 00	7, 469 55	11, 951 28	July 1, 1876	To be consolidated with Ill. route 23032. Under act of July 12, 1876.	165
10.6 by 8, f. f., a. l.	12	67 50	75 00	6, 184 35	6, 657 30	July 1, 1876	In March, 1876. 6.12 miles formerly at \$40. Under act of July 12, 1876.	166
11 by 7, f. f., a. l. . .	7*	67 50	50 00	19, 440 00	14, 400 00	July 1, 1876	About 15 pounds per day not weighed.	167
10 by 6.8, fixtures, a. l.	12	65 70	60 00	5, 788 17	5, 286 00	July 1, 1876	Under act of July 12, 1876.	168
13.2 by 6.10, f. f., a. l.	10*	65 70	65 00	6, 681 69	6, 610 50	July 1, 1876	Under act of July 12, 1876.	169
13.6 by 6.8, f. f., a. l.	7½*	65 00	50 00	12, 220 00	9, 400 00	July 1, 1875	In Oct., 1875. Main route; branch \$40, (328.) Under contract to June 30, 1875. Ordered Dec., 1875.	170
12.2½ by 6.10, f. f., a. l.	10*	65 00	80 00	6, 610 50	8, 136 00	July 1, 1875	In Oct., 1875. Under contract to June 30, 1875. Ordered Dec., 1875.	171
12 by 7.2, f. f., a. l.	7	64 80	100 00	2, 948 40	4, 550 00	July 1, 1876	Part; residue \$46.08, (285.) Under act of July 12, 1876.	172
12.8 by 6.3, f. f., a. l.	6	64 80	-----	-----	-----	July 1, 1876	Land-grant road. New; extension. 45 days, 15 from Mar. 15 and 30 from May 15, 1876. Main route; branches \$45, \$36, \$31.50. Under act of July 12, 1876.	173
12.8 by 6.3, f. f., a. l.	6	64 80	70 00	7, 474 03	8, 073 80	July 1, 1876	Main route, part; residue, \$64 80, (173;) branches \$45, \$36, \$31.50. Under act of July 12, 1876. 45 days, 15 from Mar. 15 and 30 from May 15, 1876.	174
b. c.; nor. a. . . . .	26	64 80	50 00	1, 028 37	793 50	July 1, 1876	Under act of July 12, 1876.	175
24.6 by 8.6, f. f., a. l.	13	64 00	75 00	2, 794 88	3, 315 00	July 1, 1875	In Oct., 1875. 1.0- miles decrease. \$240 m. m. Under contract to June 30, 1875. Ordered Dec., 1875.	176
18 by 8, f. f., a. l. . .	13	63 00	70 00	7, 434 00	8, 260 00	July 1, 1876	Main route; branches \$68.40, \$63, \$40.50, (156, 178, 317.) 11.28 miles decrease. Under act of July 12, 1876.	177
10 by 8, f. f., a. l. . .	13	63 00	70 00	1, 619 10	2, 149 00	July 1, 1876	Branch; main route \$63, (177.) 5 miles decrease. Under act of July 12, 1876.	178
18 by 7, f. f., a. l. . .	6½	63 00	-----	-----	-----	Feb. 1, 1875	New; in March, 1876. Ordered May, 1876.	179
15 by 8.9, f. f., a. l. .	7	63 00	-----	-----	-----	Oct. 1, 1874	In July, 1875. New; ordered Oct., 1875.	180

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds	
181	Ohio ..	9035	21031	North Bend, Hagerstown.	White Water Valley .....	72.58	444	25
182	Ohio ..	9040	21036	Columbus, Athens ...	Columbus and Hocking Valley	77.40	438	22
183	N. Y. ..	1284	.....	Cayuga, Ithaca .....	Cayuga .....	38.05	354	25
184	Ga. ....	6016	15018	Thomasville, Albany	Atlantic and Gulf .....	60.79	347	17½
185	Ky ....	20002	20002	Lexington, Nicholasville.	Kentucky Central .....	13	423	22
186	Ohio ..	9006	21005	Leavittsburg, Sharpsville.	Atlantic and Great Western ..	34.65	417	25
187	Ga. ....	15013	15013	Macon, Brunswick ..	Macon and Brunswick .....	188	439	18
188	Ala. ...	17009	17009	Selma, York Station ..	Alabama Central .....	81.7	411	16½
189	Ala. ...	17009	17009	York Station, Meridian.	.....do .....	26.5	411	16½
190	Colo. ..	38005	.....	Kitt Carson, West Las Animas.	Arkansas Valley .....	56	446	20
191	Cal. ...	46017	.....	Los Angeles, Anaheim.	Southern Pacific .....	21.7	373	20
192	N. J. ...	2106	.....	Washington, Easton ..	Morris and Essex .....	14.40	331	25
193	Ill. ...	23038	.....	Peoria, Jacksonville..	Peoria, Pekin and Jacksonville	87.40	322	19
194	Ky ....	20016	20016	Maysville, Paris .....	Maysville and Lexington .....	50	416	19½
195	N. C. ...	13001	13001	Raleigh, Weldon .....	Raleigh and Gaston .....	97	403	20
196	Ind. ...	22020	22021	Richmond, Fort Wayne.	Grand Rapids and Indiana .....	91.50	398	24
197	Va. ....	4415	11015	Portsmouth, Weldon.	Seaboard and Roanoke .....	79.26	312	30
198	Ga. ....	6008	15009	Dupont, Bainbridge..	Atlantic and Gulf .....	106.48	304	17½
199	S. C. ...	5602	14001	Columbia, Greenville..	Greenville and Columbia .....	144.01	304	15
200	R. I. ...	825	.....	Wickford Landing, Wickford Junction.	Newport and Wickford Railroad and Steamboat Comp'y.	3.40	301	30
201	Miss. ...	18004	18004	Mobile, Columbus....	Mobile and Ohio .....	472.7	752	19
202	Ohio ..	9024	21024	Hamilton, Indianapolis.	Cincinnati, Hamilton and Indianapolis.	96.49	372	24½

*in States in which the contract-term expired June 30, 1876, &c.—Continued.*

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
12 by 7.8, f. f., a. l. . .	6	62 10	62 50	4, 507 22	4, 536 25	July 1, 1876	Under act of July 12, 1876.	181
16 by 8.6, f. f., a. l. . .	12	62 10	87 50	4, 806 54	6, 772 50	July 1, 1876	Main route; branch \$40.50, (321.) Under act of July 12, 1876.	182
9.6 by 7.6, f. f., a. l. . .	9*	62 00	50 00	2, 359 10	1, 902 50	Nov. 1, 1875	In Nov., 1875.	183
12 by 6, f. f., a. l. . .	7	62 00	50 00	3, 768 98	2, 916 50	July 1, 1873	60 days, in Jan. and Oct., 1875. 2.46 miles increase.	184
12 by 6.6, fixtures, a. l.	6	61 20	75 00	795 60	975 00	July 1, 1876	Part; residue \$106.20, (100.) Under act of July 12, 1876.	185
14.4 by 7.10, f. f., a. l.	11*	61 20	50 00	2, 120 58	1, 732 50	July 1, 1876	Part; residue \$94.50, (113.) 3.04 miles formerly at \$68. Under act of July 12, 1876.	186
14 by 7, f. f., a. l. . .	6	60 30	65 00	11, 336 40	12, 220 00	July 1, 1876	Main route; branch \$36. Under act of July 12, 1876. 46 days, 16 from Mar. 15 and 30 from May 15, 1876. 7 trips part of the year.	187
124 by 72, 12 by 7, f. f., a. l.	7	60 30	56 00	4, 926 51	4, 575 20	July 1, 1876	Under act of July 12, 1876. 45 days, 15 from March 15 and 30 from May 15, 1876. Average speed.	188
12.4 by 7.2, 12 by 7, f. f., a. l.	7	60 30	-----	-----	-----	July 1, 1876	New; extension of old route. Under act of July 12, 1876. 45 days, 15 from Mar. 15 and 30 from May 15, 1876. Average speed.	189
in h. c.; no r. a. . .	7	60 00	-----	-----	-----	July 1, 1874	In Sept., 1875. New; ordered Jan., 1876.	190
no r. a. . .	7	60 00	-----	-----	-----	Nov. 16, 1875	In Aug., 1876. New; ordered Sept., 1876.	191
11.7 by 7.7, f. f., a. l.	6	60 00	50 00	864 00	720 00	July 1, 1873	In July, 1874; report ed Nov., 1875. Part; residue \$131, \$141, (81.) Ordered Dec., 1875.	192
12.4 by 8, f. f., a. l.	6½*	60 00	75 00	5, 244 00	6, 555 00	July 1, 1875	In March, 1875. Ordered Sept., 1876.	193
10 by 7.6, f. f., a. l.	6	59 40	59 00	2, 970 00	2, 950 00	July 1, 1876	Under act of July 12, 1876.	194
12 by 9, f. f., a. l. . .	6	59 40	75 00	5, 761 80	7, 275 00	July 1, 1876	...do	195
14.6 by 6.10, fixtures, a. l.	12	59 40	50 00	5, 435 10	4, 575 00	July 1, 1876	...do	196
20.6 by 8.6, f. f. c. and m. c., a. l.	6½*	59 00	75 00	4, 676 34	6, 000 00	July 1, 1875	In Oct., 1875. Under contract to June 30, 1875. .74 mile decrease.	197
12 by 8, 12 by 6, f. f., a. l.	7	58 00	50 00	6, 175 84	5, 275 00	July 1, 1873	60 days, in Jan. and Oct., 1875. Branch; main route \$120, (86.) 98 mile increase. Ordered Dec., 1875.	198
12 by 7, f. f., a. l. . .	6	58 00	75 00	8, 352 58	10, 762 50	July 1, 1875	In Oct., 1875. Ordered Nov., 1875. 51 mile increase. Main route; branches \$50, (262, 267.) Under contract to June 30, 1875.	199
No apt.; no r. a. . .	15½*	58 00	-----	-----	-----	Sept. 21, 1874	In Oct., 1875. New; ordered Dec., 1875.	200
21.6 by 8.6, f. f., a. l.	7	57 60	82 00	27, 227 52	38, 761 40	July 1, 1876	Under act of July 12, 1876. Land-grant road.	201
10.5 by 7.3, f. f., a. l.	15½*	57 60	50 00	5, 730 62	4, 974 50	July 1, 1876	Under act of July 12, 1876.	202

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
230	Utah	41002	.....	Provo City, York	Utah Southern	27	235	15
231	Ill	23050	.....	Robinson, Danville	Paris and Danville	82.38	233	18
232	Ohio	9037	21033	Springfield, Columbus	Cincinnati, Sandusky and Cleveland.	45.86	228	30
233	N. Y.	1811	.....	Rochester, Charlotte	New York Central and Hudson River.	9	225	25
234	N. Y.	1223	.....	Schenectady, Ballston	Delaware and Hudson Canal Company.	16	224	30
235	S. C.	14010	14010	Port Royal, Augusta	Port Royal	112.2	306	20
236	Ohio	9034	21030	Dayton, Richmond	Pittsburgh, Cincinnati and Saint Louis.	42	226	25
237	N. C.	13012	13012	Greensboro', Salem	Northwestern North Carolina	29.31	224	14
238	Md	3513	10012	Clayton, Chestertown	Kent County	30.80	220	16
239	Me	231	.....	West Waterville, North Anson.	Somerset	25.7	220	20
240	Mich	24008	.....	Jackson, Fort Wayne	Fort Wayne, Jackson and Saginaw.	26.82	220	22
241	Ky	27962	20013	Anchorage, Shelbyville.	Louisville, Cincinnati and Lexington.	19	217	20
242	Del	3406	2506	Georgetown, Selbyville.	Breakwater and Frankford	19.30	203	14
243	Iowa	27016	.....	Washington, Oskaloosa.	Chicago, Rock Island and Pacific.	54.01	202	24
244	N. Y.	1295	.....	New York, Babylon	Southern, of Long Island	36.25	185	20
245	Wis	25026	.....	Eau Claire, Chippewa Falls.	Chippewa Falls and Western	11.67	183	25
246	Md	3517	.....	Selbyville, Stockton	Worcester	31.44	181	14
247	N. Y.	1812	.....	Rhine Cliff, Boston Corner.	Rhinebeck and Connecticut	35.2	179	14
248	Vt	532	.....	White River Junction, Woodstock.	Woodstock	14.53	176	18
249	Miss	7004	18004	Artesia, Columbus	Mobile and Ohio	14	171	9
250	N. Y.	1296	.....	Flushing, Whitestone	Flushing, North Side and Central.	3.12	163	25
251	Mich	24036	.....	Grosse Isle, Fayette	Chicago and Canada Southern	70.30	160	25
252	Ill	23048	.....	Terre Haute, Peoria	Illinois Midland	179.93	160	27
253	N. J.	2124	.....	Newark, Mont Clair	Newark and Bloomfield	5.67	157	25
254	Ill	23043	.....	Streator, Altamont	Chicago and Paducah	156.80	152	20
255	Cal	46016	.....	Sausalito, Tomales	North Pacific Coast	49.18	146	16
256	Ill	23029	.....	Urbana, Havana	Indianapolis, Bloomington and Western.	102.70	144	20
257	N. Y.	1296	.....	Bayside, Manhasset	Flushing, North Side and Central.	3.03	144	25
258	N. Y.	1810	.....	Bath, Hammondsport	Bath and Hammondsport	9.4	139	18



in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i> 15 by 8.9, f. f., a. l.	7	Dolls. 52 00	Dolls.	Dolls.	Dolls.	Dec. 16, 1875	In July, 1875. Extension. New; ordered Oct., 1875.	230
12 by 7, fixtures, a. l.	6	52 00				Oct. 1, 1875	New; ordered Mar., 1876.	231
16 by 8.6, f. f. and m. c., a. l.	6	52 00	50 00	2,384 72	2,293 00	Jan. 1, 1875	In April, 1875. Ordered Feb., 1876.	232
b. c.; no r. a. ....	12	52 00				Oct. 1, 1875	In Nov., 1875. New; ordered Mar., 1876.	233
no r. a. ....	6	52 00	50 00	832 00	800 00	July 1, 1873	60 days, in May and Aug., 1875. Ordered Nov., 1875.	234
10.6 by 6.10, f. f., a. l.	6	51 30	50 00	5,755 86	5,614 00	July 1, 1876	51 days, 21 from Mar. 15 and 30 from May 15, 1876. .08 mile decrease. Under act of July 12, 1876.	235
14 by 8.7, f. f., a. l.	12	51 30	65 00	2,154 60	2,730 00	July 1, 1876	Under act of July 12, 1876.	236
21 by 8.2, f. f., a. l.	6	51 30	50 00	1,503 60	1,465 50	July 1, 1876	do	237
16 by 6, f. f., a. l. ....	6	51 30	75 00	1,580 04	2,107 50	July 1, 1876	11.25 miles formerly at \$57. Under act of July 12, 1876.	238
12.6 by 6.6, f. f., a. l.	6	51 00	50 00	1,310 70	1,285 00	Jan. 10, 1876	In March, 1876	239
10.4 by 7.2, f. f., a. l.	6	51 00	57 00	4,937 82	5,518 74	July 1, 1875	In April, 1875. Ordered Nov., 1875.	240
r. a. in b. c., d. l. ....	12	51 00	50 00	969 00	950 00	July 1, 1873	In Aug., 1875. Ordered Nov., 1875.	241
7 by 7, fixtures, a. l.	6	50 00				Jan. 16, 1875	New; ordered June, 1876.	242
10 by 9, f. f., a. l. ....	6	50 00				Feb. 16, 1876	In July, 1876. New; ordered Aug., 1876.	243
12 by 6, f. f., a. l. ....	12	50 00				Nov. 1, 1874	In Aug., 1875. New; ordered Nov., 1875.	244
b. c.; no r. a. ....	12	50 00				Feb. 1, 1875	In May, 1876. New; ordered June, 1876.	245
7 by 7, fixtures, a. l.	6	50 00				Nov. 1, 1875	In Mar., 1876. New; ordered June, 1876.	246
7 by 6, f. f., a. l. ....	6	50 00				Jan. 1, 1876	New; ordered May, 1876. In March, 1876.	247
b. c.; no r. a. ....	12	50 00				Nov. 1, 1875	In Jan., 1876. New; ordered Mar., 1876.	248
in b. c.; no r. a. ....	14	50 00	60 00	700 00	840 00	July 1, 1873	In Oct., 1875. Ordered Nov., 1875. Branch; main route \$82, (127.)	249
12 by 6, f. f., a. l. ....	12	50 00				Nov. 1, 1874	Branch; main route \$57, (204.) In Aug., 1875. New; ordered Nov., 1875.	250
10.9 by 9.3, f. f., a. l.	6	50 00				Jan. 16, 1874	New; ordered Oct., 1875.	251
11.3 by 8.2, f. f., a. l.	6	50 00				Mar. 16, 1875	In Apr., 1875. New; ordered Nov., 1875.	252
no apt; no r. a. ....	12	50 00	48 60	283 50	275 56	July 1, 1873	In July, 1874; reported Nov. 1, 1875. Ordered Dec., 1875.	253
12 by 8, f. f., a. l. ....	6	50 00				Oct. 16, 1874	New; ordered Nov., 1875.	254
11 by 6, fixtures, a. l.	6	50 00				Apr. 20, 1875	In May, 1876. New; ordered July, 1876.	255
10 by 7, furniture, a. l.	6	50 00	40 00	5,135 00	4,108 80	July 1, 1874	In Nov., 1875. Ordered Dec., 1875. Main route; branch \$45, (298.)	256
no r. a. ....	12	50 00				Nov. 1, 1874	Branch; main route \$57, (204.) In Aug., 1875. New; ordered Nov., 1875.	257
in b. c. ....	15*	50 00				Sept. 15, 1875	New; ordered May, 1876.	258

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
259	Pa....	2496	8094	York, Delta .....	Peach Bottom.....	35.56	133	15
260	Mass	755	.....	North Brookfield, East Brookfield.	Boston and Albany Railroad Company, (leases North Bloomfield Railroad.)	4.41	130	22
261	Wis ..	25025	.....	Galena, Platteville...	Galena and Southern Wisconsin.	30.69	129	12
262	N. Y..	1288	.....	Theresa Junction, Clayton.	Utica and Black River .....	16.25	128	20
263	Oreg.	44002	.....	Portland, Saint Joseph.	Oregon Central.....	48.61	120	12
264	Pa....	2500	.....	New Castle, Stone- borough.	New Castle and Franklin.....	36.5	105	15
265	S. C...	5602	14001	Cokesbury, Abbe- ville Court House.	Greenville and Columbia.....	11.81	104	15
266	Cal ...	46015	.....	Elmira, Winters.....	Vaca Valley.....	18	100	20
267	S. C...	5602	14001	Belton, Anderson Court House.	Greenville and Columbia.....	10.01	96	15
268	Md ...	3520	.....	Emmitsburgh, Rocky Ridge.	Emmitsburgh .....	7	96	21
269	Ohio...	9052	21048	Dyson's, Cumberland	W. H. and C. R. Stevens, pro- priators of the Eastern Ohio Railroad.	7.8	62	15
270	Mass	754	.....	New Bedford, Fall River.	Fall River.....	15	60	25
271	Mass	753	.....	Ashburnham Depot, Ashburnham.	Ashburnham .....	2.89	57	15
272	W. Va	12005	.....	Ritchie Court-House, Pennsborough.	Pennsborough and Harrisville	9	54	12
273	Ga....	6028	15017	Fort Valley, Perry...	Southwestern .....	13.32	49	15
274	N. C...	5216	13011	Sandford, Egypt De- pot.	Western .....	7	23	...
275	Pa....	2493	.....	Phillipsburgh, Mor- riisdale Mines.	Pennsylvania .....	3.69	23	20
276	Pa....	2492	.....	Antestown, Lloyd- ville.	Bell's Gap.....	8.22	11	12
277	N. C...	13003	13003	Wilmington, Char- lotte.	Carolina Central.....	195.90	269	17
278	Ohio...	9026	21022	Dayton, Union City..	Dayton and Union.....	48.17	260	20
279	Ky ...	20017	20017	Lexington, Mount Sterling.	Louisville, Cincinnati and Lexington.	33.84	267	22
280	Pa....	2431	8031	Columbia, Sinking Springs.	Reading and Columbia .....	39.70	250	20
281	Ohio...	9024	21020	Fremont, Saint Mary's.	Lake Erie and Louisville.....	69.35	247	20
282	Ind...	22027	22022	Rockville, Logans- port.	Logansport, Crawfordsville and Southwestern.	92.10	247	22
283	Ohio...	9041	21037	Niles, New Lisbon...	Atlantic and Great Western ..	33.94	245	20
284	Ohio...	9050	21046	Painesville, Youngs- town.	Painesville and Youngstown ..	60.12	229	18
285	Miss...	18003	18003	Jackson, Meridian...	Vicksburg and Meridian .....	95.2	379	18

*in States in which the contract-term expired June 30, 1876, &c.—Continued.*

Sta. &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Fit and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
86 by 7.3, fixtures, a.l.	6	50 00	.....	.....	.....	Jan. 30, 1876	In Mar., 1876. New; ordered May, 1876.	250
in b.c. ....	24	50 00	.....	.....	.....	Jan. 17, 1876	.....do .....	260
12 by 7, f.f., a.l.	6	50 00	.....	.....	.....	June 1, 1875	In Jan., 1876. New; ordered Mar., 1876.	261
in charge of baggage-master.	12	50 00	.....	.....	.....	Mar. 15, 1875	Part; residue \$75, (144;) branch \$57, (205.) New; ordered May, 1876.	262
8 by 8, f.f., a.l.	6	50 00	.....	.....	.....	Apr. 1, 1875	In Sept., 1875. New; ordered Nov., 1875.	263
11 by 3.10, f.f., a.l.	6	50 00	.....	.....	.....	July 1, 1875	In Dec., 1875. New; ordered Jan., 1876.	264
in charge of conductor.	6	50 00	30 00	590 50	345 00	July 1, 1875	Branch; main route \$58, (199.) .31 mile increase. Under contract to June 30, 1875. Ordered Nov., 1875.	265
in b.c.; no r.a.	7	50 00	.....	.....	.....	Jan. 16, 1876	In Aug., 1876. New; ordered Sept., 1876.	266
12 by 7, f.f., a.l.	6	50 00	30 00	500 50	292 50	July 1, 1875	In Oct., 1875. Ordered November, 1875. Branch; main route \$58, (199.) .26 mile increase. Under contract to June 30, 1875.	267
in express-car.	12	50 00	.....	.....	.....	Dec. 5, 1875	In Jan., 1876. New; ordered Feb., 1876.	268
6 by 4, f.f.; no r.a.	12	50 00	.....	.....	.....	Jan. 16, 1875	New; ordered Sept., 1876. In July, 1876.	269
in b.c.	18	50 00	.....	.....	.....	Dec. 15, 1875	In Mar., 1876. New; ordered May, 1876.	270
no apt.; no r.a.	12	50 00	.....	.....	.....	July 1, 1875	In Mar., 1876. New; ordered April, 1876.	271
10 by 7.4; no r.a.	12	50 00	.....	.....	.....	Jan. 1, 1876	In May, 1876. New; ordered Aug., 1876.	272
3 by 4; no r.a.	6	50 00	.....	.....	.....	Feb. 1, 1874	In Oct., 1875. New; ordered Feb., 1876.	273
no r.a.	6	50 00	21 00	350 00	147 00	July 1, 1875	In August, 1875. Branch; main route \$50. Ordered Oct., 1875.	274
b.c.; no r.a.	6	50 00	.....	.....	.....	Oct. 1, 1874	In Aug., 1875. New; ordered Oct., 1875.	275
7 by 6.6; no r.a.	6	50 00	.....	.....	.....	Oct. 1, 1874	In Aug., 1875. New; ordered Nov., 1875.	276
14 by 8.11, f.f., a.l.	13	49 50	55 00	9,697 05	10,431 30	July 1, 1876	6.34 miles increase. In Dec., 1875. Under act of July 12, 1876.	277
11 by 7.4, f.f., a.l.	12	49 50	60 00	2,384 42	2,890 20	July 1, 1876	Under act of July 12, 1876.	278
8.6 by 6, f.f., a.l., and b.c.	12	48 60	50 00	1,644 63	1,692 00	July 1, 1876	.....do .....	279
7.4 by 6.8, f.f., a.l.	18	48 80	50 00	1,929 42	1,985 00	July 1, 1876	.....do .....	280
12 by 7, fixtures, a.l.	6	47 70	50 00	4,202 00	4,467 50	July 1, 1876	.....do .....	281
12 by 8.9, f.f., a.l.	6	47 70	50 00	4,393 17	4,605 00	July 1, 1876	.....do .....	282
15.3 by 7.3, f.f., a.l.	6	47 70	50 00	1,618 94	1,697 00	July 1, 1876	.....do .....	283
12 by 6, f.f., a.l.	6	46 80	40 00	2,813 62	2,517 36	July 1, 1876	9.38 miles formerly at \$52. Under act of July 12, 1876.	284
12 by 7.2, f.f., a.l.	7	46 08	50 00	4,326 81	5,616 80	July 1, 1876	Part; residue \$64.80, (172.) Under act of July 12, 1876. Land-grant road.	285

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
286	Ala...	17003	17003	Montgomery, Eufaula	Montgomery and Eufaula ....	81.24	233	16
287	Ohio..	9019	21017	Blanchester, Hillsborough.	Marietta and Cincinnati.....	21	216	25
288	Ala...	17002	17002	Montgomery, Selma..	Western, of Alabama .....	50	205	23
289	N. C..	13010	13010	Raleigh, Cameron....	Raleigh and Augusta Air Line.	58.78	905	20
290	S. C....	14006	14006	Florence, Cheraw....	Cheraw and Darlington .....	40.88	194	13½
291	N. J..	2113	7021	Elmer, Salem .....	West Jersey .....	16.60	188	23½
292	Ohio..	9039	21035	Youngstown, Cross Cut.	Pittsburgh, Fort Wayne and Chicago.	22.8	185	22
293	Ky...	20013	20013	Anchorage, Shelbyville.	Shelby .....	19	179	18
294	Ind...	22011	22011	Cambridge City, Columbus.	Jeffersonville, Madison and Indianapolis.	68	162	20
295	Ga....	15009	15009	Dupont, Bainbridge..	Atlantic and Gulf .....	106.37	160	18
296	Ga....	15018	15018	Thomasville, Albany.	Atlantic and Gulf .....	58.91	140	17½
297	S. C....	14009	14009	Anderson C. H., Walhalla.	Greenville and Columbia .....	35.06	133	15
298	Ill .....	23029	.....	White Heath, Decatur.	Indianapolis, Bloomington and Western.	32.35	121	12
299	Ga....	6146	15022	Griffin, Carrollton ...	Savannah, Griffin and North Alabama.	59.86	107	12
300	Ill .....	23054	.....	Chicago, Byron .....	Chicago and Pacific .....	92.75	97	20
301	Pa....	2461	8061	Towanda, Bernice....	Sullivan and Erie Coal and Railroad Company.	29.32	96	14
302	N. C..	5213	13009	Charlotte, Statesville	Atlantic, Tennessee and Ohio..	49.38	89	15
303	Ala...	6611	17011	Gainesville, Gainesville Junction.	Mobile and Ohio.....	22	87	11
304	Pa....	2494	.....	Reading, Statington..	Philadelphia and Reading, (leases Berks County Railroad.)	43.32	81	18½
305	Pa....	2489	.....	Holidaysburgh, Royer.	Pennsylvania.....	21.25	81	14
306	Ala...	17005	17005	Moscow, Somerville..	Memphis and Charleston.....	14.5	75	18
307	Ohio..	9010	21009	Oneida Mills, Carrollton.	Ohio and Toledo.....	12	74	15
308	Ill .....	23032	.....	McLeansboro', Shawneetown.	Saint Louis and Southeastern..	41.25	62	12
309	Pa....	2495a	.....	Larabee's, Clermont.	McKean and Buffalo.....	23.3	61	15
310	N. Y..	1802	.....	Quaker Street, Schenectady.	Delaware and Hudson Canal Company.	15	57	30
311	N. Y..	1803	.....	Nineveh Junction, Jefferson Junction.	.....do.....	21	52	33
312	Fla...	16003	16003	Pensacola, Whiting Junction.	Pensacola and Louisville .....	44.05	338	13

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
9.5 by 6.6, f. f., a. l.	7½	45 90	50 00	3, 728 91	4, 062 00	July 1, 1876	48 days, 18 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	286
b. c.; no r. a. ....	12	45 90	81 00	963 90	1, 701 00	July 1, 1876	Under act of July 12, 1876.	287
13 by 8.6, f. f., a. l.	7	45 00	54 00	2, 250 00	2, 700 00	July 1, 1876	45 days, 15 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	288
11.2 by 9, f. f., a. l.	6	45 00	53 00	2, 645 10	3, 076 34	July 1, 1876	Weight to Sanford, 45.78 miles. 13 miles formerly at \$50.	289
13 by 9.9, f. f., a. l.	6	45 00	53 00	1, 839 60	2, 166 64	July 1, 1876	Under act of July 12, 1876.	290
10.7 by 6.6; no r. a.	12	45 00	60 24	747 00	999 98	July 1, 1876	In Mar., 1876. Under act of July 12, 1876.	291
9.4 by 8.10, fixtures, a. l.	6	45 00	53 00	1, 026 00	1, 208 40	July 1, 1876	Under act of July 12, 1876.	292
12 by 5, fixtures, a. l.	12	45 00	51 00	855 00	969 00	July 1, 1876	.....do .....	293
11 by 6, f. f., a. l. ....	6	45 00	40 00	3, 060 00	2, 720 00	July 1, 1876	.....do .....	294
12 by 7, (av.), f. f., a. l.	7	45 00	58 00	4, 786 65	6, 175 84	July 1, 1876	Branch; main route \$112.80, (.88), .11 mile decrease. Under act of July 12, 1876.	295
12 by 6, f. f., a. l. ....	7	45 00	62 00	2, 650 95	3, 768 98	July 1, 1876	1.88 miles decrease. Under act of July 12, 1876.	296
12 by 8, f. f. ....	6	45 00	40 00	1, 577 70	1, 360 00	July 1, 1876	1.06 miles increase. Under act of July 12, 1876.	297
8 by 4, furniture, a. l.	6	45 00	40 00	1, 435 75	1, 294 00	July 1, 1874	Branch; main route \$50, (.256.) In Nov., 1875. Ordered Dec., 1875.	298
8.6 by 4.6, f. f., a. l.	6	45 00	30 00	2, 693 70	1, 830 00	July 1, 1875	In Dec., 1875. 1.14 miles decrease. Ordered Feb., 1876.	299
22.6 by 10, f. f., a. l.	6	45 00	.....	.....	.....	July 1, 1875	In Jan., 1876. New; ordered Mar., 1876.	300
2.3 by 7.3, fixtures, a. l.	6	45 00	.....	.....	.....	July 1, 1873	New; ordered July, 1876.	301
9 by 8, f. f., a. l. ....	6	45 00	40 00	2, 222 10	1, 940 40	July 1, 1875	In Oct., 1875. .87 mile increase. Ordered Dec., 1875.	302
in b. c.; no r. a. ....	7	45 00	50 00	990 00	1, 100 00	July 1, 1873	In October, 1875. Ordered Nov., 1875.	303
6.9 by 5.2, f. f., a. l.	6	45 00	.....	.....	.....	Oct. 1, 1874	In Aug., 1875. New; ordered Oct., 1875.	304
b. c.; no r. a. ....	9.8*	45 00	.....	.....	.....	July 1, 1874	In Aug., 1875. New; ordered Oct., 1875.	305
in b. c.; no r. a. ....	7	45 00	30 00	652 50	435 00	July 1, 1876	Branch; main route \$99, (.108.) Under act of July 12, 1876.	306
12 by 10; no r. a. ....	6	45 00	41 66	540 00	500 00	July 1, 1876	Under act of July 12, 1876.	307
12 by 6.6, f. f., a. l.	6	45 00	50 00	1, 856 25	2, 062 50	July 1, 1875	Branch; main route \$24, (.125.) In Mar., 1875. Reported October, 1875. Ordered Oct., 1875.	308
8 by 5.6, (av.), fixtures, a. l.	6	45 00	.....	.....	.....	Aug. 16, 1875	New; ordered May, 1876.	309
no apt. ....	6	45 00	.....	.....	.....	Mar. 15, 1875	60 days, in May and Aug., 1875. New; ordered Nov., 1875.	310
7 by 7, a. l. ....	6	45 00	.....	.....	.....	Mar. 15, 1875	In May, 1875. New; ordered Nov., 1875.	311
7.6 by 7, f. f., a. l. ....	13	43 20	50 00	1, 902 96	2, 202 50	July 1, 1876	.05 m. increase. Under act of July 12, 1876. Land-grant road.	312

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
313	Ind . . .	23032	22033	Frankfort, Kokomo..	Frankfort and Kokomo.....	25.5	112	20
314	Tenn..	19011	19011	Knoxville, Caryville.	Knoxville and Ohio.....	38.94	121	12
315	Ky . . .	20006	20006	Bardstown Junction, Bardstown.	Louisville and Nashville .....	17.3	114	14
316	Ala . . .	17017	17017	Selma, Pine Apple...	Selma and Gulf.....	43.19	110	10
317	S. C. . .	14003	14003	Kingsville, Camden..	South Carolina .....	39.25	99	13
318	Ky . . .	20007	20007	Richmond Junction, Fish Point.	Louisville and Nashville .....	33.5	96	13
319	Ohio . .	9054	21050	Athens, Scott's Landing.	Marietta and Cincinnati.....	37	89	12
320	Ala . . .	17016	17016	Opelika, Goodwater..	Savannah and Memphis .....	59.65	77	15
321	Ohio . .	9040	21036	Logansport, New Straitsville.	Columbus and Hocking Valley.	13.02	62	12
322	Ala . . .	17008	17008	Columbus, Troy .....	Mobile and Girard .....	90	274	18
323	N. J. . .	2118	.....	Greensburgh Station, New Brunswick.	Pennsylvania.....	29.13	106	25
324	Ala . . .	6617	17017	Selma, Pine Apple...	Selma and Gulf.....	43.19	102	12
325	Miss..	7009	18009	Durant, Kosciusko...	New Orleans, Saint Louis and Chicago, (operating Mississippi Central.)	21.57	84	12
326	Minn..	26017	.....	Mankato, Wells.....	Central, of Minnesota.....	41.06	83	15
327	N. J. . .	2120	.....	New Bridge, Stony Point.	New Jersey and New York....	27.18	83	25
328	Ga....	6012	15013	Cochran, Hawkinsville.	Macon and Brunswick .....	10	72	24
329	Pa....	2485	.....	Mechanicsburgh, Dillsburgh.	Cumberland Valley .....	8.85	58	15
330	Ala . . .	6614	17014	Opelika, Buffalo.....	East Alabama and Cincinnati..	22.50	54	20
331	Pa....	2498	.....	Oxford, Goshen.....	Peach Bottom .....	16.75	36	14
332	Md . . .	3519	.....	Lake Roland, Western Maryland Railroad Junction.	Northern Central.....	8.5	23	17
333	Miss..	7007	18007	Muldon, Aberdeen...	Mobile and Ohio.....	9	11	9
334	Ohio . .	9042	21038	Newark, Shawnee ...	Newark, Somerset and Straitsville.	44.045	63	27
335	Ala . . .	17021	17021	Eufaula, Clayton....	Vicksburgh and Brunswick....	22.5	54	22
336	Ga....	15017	15017	Fort Valley, Perry...	Southwestern .....	13.32	50	13
337	Ind . . .	22033	.....	Rockport, Huntingburg.	Cincinnati, Rockport and Southwestern.	31.02	48	15

in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
10.10 by 7.2, f. f., a. l.	12	43 20	40 00	1,101 60	1,020 00	July 1, 1876	Under act of July 12, 1876.	313
6.2 by 3, fixtures, a. l.	6	40 50	40 00	1,577 07	1,557 60	July 1, 1876	... do .....	314
b. c.; no r. a. ....	7	40 50	40 00	700 65	692 00	July 1, 1876	... do .....	315
7.3 by 6, f. f., $\frac{1}{2}$ l.	4	40 50	40 00	1,749 20	1,727 60	July 1, 1876	48 days, 18 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	316
in charge of conductor.	6	40 50	50 00	1,589 63	1,897 50	July 1, 1876	Branch; main route \$63, (177.) 1.3 m. increase. Under act of July 12, 1876.	317
b. c. ....	6	40 50	54 00	1,356 75	1,809 00	July 1, 1876	Main route; part; res. \$69.30, (154.) branch \$54.90, (214.) Under act of July 12, 1876.	318
14.6 by 9.6, f. f., a. l.	6	40 50	50 00	1,498 50	1,850 00	July 1, 1876	Under act of July 12, 1876.	319
8.2 by 7, f. f., a. l.	6	40 50	50 00	2,415 83	2,858 80	July 1, 1876	12.37 miles formerly at \$40. In March, 1876. Under act of July 12, 1876.	320
in b. c.; no r. a. ....	15*	40 50	40 00	527 31	520 80	July 1, 1876	Branch; main route \$62.10, (182.) Under act of July 12, 1876.	321
12 by 7, f. f., a. l. ....	6	40 32	50 00	3,628 80	4,500 00	July 1, 1876	49 days, 19 from Mar. 15 and 30 from May 15, 1876. 7 trips from Aug. 1, 1876. Under act of July 12, 1876. Land-grant road.	322
in b. c.; no r. a. ....	6	40 00	.....	.....	.....	Mar. 1, 1875	In Oct., 1875. New; ordered Feb., 1876.	323
7.3 by 6, fixtures, $\frac{1}{2}$ l.	4	40 00	50 00	1,727 60	2,159 50	July 1, 1875	In Oct., 1875. Under contract to June 30, 1875. Ordered Dec., 1875.	324
b. c.; no r. a. ....	6	40 00	.....	.....	.....	Oct. 1, 1874	In Oct., 1875. New; ordered Dec., 1875.	325
8.3 by 7, f. f., a. l. ....	6	40 00	.....	.....	.....	Mar. 1, 1875	In Oct., 1875. New; ordered Jan., 1876.	326
b. c.; no r. a. ....	6	40 00	.....	.....	.....	Nov. 1, 1875	In Mar., 1876. New; ordered May, 1876.	327
no r. a. ....	6	40 00	50 00	400 00	500 00	July 1, 1875	In Oct., 1875. Br'ch; main route \$65, (170.) Under contract to June 30, 1875. Ordered Dec., 1875.	328
locked box in b. c.	6	40 00	.....	.....	.....	Dec. 16, 1873	In Aug., 1875. New; ordered Feb., 1876.	329
6 by 4, f. f., a. l. ....	6	40 00	30 00	900 00	675 00	July 1, 1875	In Oct., 1875. Ordered Dec., 1875.	330
b. c.; no r. a. ....	6	40 00	.....	.....	.....	Apr. 15, 1875	In Jan., 1876. New; ordered Mar., 1876.	331
in b. c.; no r. a. ....	6	40 00	.....	.....	.....	Jan. 1, 1875	New; ordered June, 1876.	332
in b. c.; no r. a. ....	14	40 00	50 00	360 00	450 00	July 1, 1873	In Oct., 1875. Ordered Nov., 1875.	333
14 by 9, f. f., a. l. ....	8 $\frac{1}{2}$ *	36 00	75 00	1,585 62	3,303 37	July 1, 1876	Under act of July 12, 1876.	334
3 by 4, a. l. ....	6	36 00	50 00	810 00	1,125 00	July 1, 1876	50 days, 20 from Mar. 15 and 30 from May 15, 1876. Under act of July 12, 1876.	335
closet 3 by 4; no r. a.	6	38 00	50 00	479 52	666 00	July 1, 1876	Under act of July 12, 1876.	336
10 by 8; in charge of conductor.	6	35 00	.....	.....	.....	Oct. 1, 1875	New; ordered May, 1876.	337

F.—Table showing the re-adjustment of the rates of pay per mile on railroad-routes

Order.	State.	Number of route.	New number of route.	Termini.	Corporate title of company carrying the mail.	Length of route.	Average weight of mails whole distance per day.	Miles per hour.
						Miles.	Pounds.	
338	Kans	33014	.....	Fort Scott, Memphis	Fort Scott, Southwestern and Memphis.	6.52	32	12
339	Mo ...	23031	.....	Saint Louis, Normandy.	West End Narrow Gauge .....	10.53	27	15
340	Ga....	15024	15024	Columbus, Hamilton	North and South.....	23.51	38	15
341	Ark ..	7525a	29003	Chicot, Pine Bluff....	Texas, Mississippi River and Northwestern.	72.78	40	12
342	Ky ...	9605	20001	Ashland, Coalton ...	Lexington and Big Sandy .....	11	34	12
343	Pa.....	2499	.....	Pittsburgh, Castle Shannon.	Pittsburgh and Castle Shannon	7	15	12
344	Ark ..	7645a	29004	Chicot, Monticello ...	Texas, Mississippi River and Northwestern.	44.28	57	5
345	Fla ...	16002	16002	Tallahassee, Saint Mark's.	Jacksonville, Pensacola and Mobile.	21.89	17	16
346	La....	8003	30005	Baton Rouge, Livonia	Baton Rouge, Grosse Tête and Opelousas.	28	10	10

Excess of present over former amount of annual pay, by re-adjustment.....  
Amount of reductions made under act of July 12, 1876, on re-adjusted routes in this table, in the on and after July 1, 1876.....

Excess, apart from reductions made under act of July 12, 1876.....



in States in which the contract-term expired June 30, 1876, &c.—Continued.

Size, &c., of mail-car or apartment.	Trips per week.	Pay per mile per annum.	Former pay per mile per annum.	Amount of annual pay.	Former amount of annual pay.	Date of re-adjustment or adjustment.	Remarks.	Order.
<i>Feet and inches.</i>		<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>	<i>Dolls.</i>			
in b. c. ....	6	35 00				July 1, 1875	In March, 1876. \$100 m. m. New; ordered April, 1876.	338
in b. c.; no r. a. .	6	35 00				Jan. 1, 1876	In May, 1876. New; ordered Sept., 1876.	339
16 by 7; no r. a. .	6	31 50	45 00	740 57	1,057 95	July 1, 1876	Under act of July 12, 1876.	340
8 by 6, f. l., a. l. .	3	30 00	45 00	2,183 40	3,275 10	July 1, 1875	In March, 1875. Ordered Jan., 1876.	341
locked box; no r. a.	6	30 00	29 54	330 00	324 94	July 1, 1874	In April, 1875. Ordered Oct., 1875.	342
no r. a. ....	6	30 00				Apr. 1, 1875	New; ordered Sept., 1876.	343
no r. a. ....	2	20 00	40 00	885 60	1,771 20	July 1, 1875	In March, 1875. Ordered Jan., 1876.	344
no apt.; in charge of conductor.	3	20 00	30 00	437 80	656 70	July 1, 1875	60 days, $\frac{1}{2}$ from Nov. 15, 1875, and residue from Jan. 1, 1876. Branch; main route \$80, (132.) Ordered Feb., 1876.	345
In passenger-car.	3	20 00	12 86	560 00	360 08	July 1, 1875	In Sept., 1875. Ordered Dec., 1875.	346
				4,999,280 67	4,963,152 70			
				4,963,152 70				
				36,127 97				
case of re-adjustments taking effect				170,430 52				
				206,558 49				

THOS. J. BRADY,  
Second Assistant Postmaster-General.

## Index to Table F.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Adirondack.....	148	1804	.....	Cincinnati, Hamilton and Indianapolis.....	202	9028	21024
Alabama Central.....	188	17009	17009	Cincinnati, La Fayette and Chicago.....	37	22028	22039
Do.....	189	17009	17009	Cincinnati, Richmond and Chicago.....	129	9029	21025
Arkansas Valley.....	190	34005	.....	Cincinnati, Rockport and Southwestern.....	337	22033	.....
Ashburnham.....	271	753	.....	Cincinnati, Sandusky and Cleveland.....	122	9013	21012
Atchison and Nebraska.....	141	33009	.....	Do.....	232	9037	21033
Atchison, Topeka and Santa Fé.....	137	33013	.....	Cleveland and Pittsburgh.....	90	9003	21003
Atlanta and Richmond Air Line.....	128	15001	15001	Do.....	91	9003	21003
Atlantic and Great Western.....	113	9006	21005	Do.....	221	9009	21008
Do.....	120	9038	21034	Cleveland, Columbus, Cincinnati and Indianapolis.....	32	9046	21042
Do.....	186	9006	21005	Do.....	54	9018	21016
Do.....	283	9041	21037	Do.....	116	9015	21013
Atlantic and Gulf.....	86	6008	15009	Cleveland, Tuscarawas Valley and Wheeling, (late Lake Shore and Tuscarawas Valley).....	163	9045	21041
Do.....	82	15009	15009	Columbus and Hooking Valley.....	1-2	9040	21036
Do.....	184	6016	15018	Do.....	321	9040	21036
Do.....	192	6008	15009	Columbus and Xenia.....	21	9016	21014
Do.....	295	15009	15009	Columbus, Chicago and Indiana Central.....	25	9017	21015
Do.....	296	15018	15018	Consolidated European and North American.....	119	244	.....
Atlantic and North Carolina.....	224	13005	13005	Cumberland Valley.....	329	2485	.....
Atlantic and West Point.....	61	15003	15003	Dayton and Michigan.....	95	9027	21023
Atlantic, Tennessee and Ohio.....	302	5213	13009	Dayton and Union.....	278	9026	21022
Baltimore and Ohio.....	10	3503	.....	Delaware and Hudson Canal Company.....	58	1222	.....
Do.....	14	3503	.....	Do.....	62	1221	.....
Do.....	17	3504	10003	Do.....	64	1224	.....
Do.....	23	3504	10003	Do.....	80	1230	.....
Do.....	27	12002	.....	Do.....	99	1224	.....
Do..... (lessees Sandusky, Mansfield and Newark).....	30	9011	.....	Do.....	103	1245	.....
Do.....	49	9011	.....	Do.....	106	1224	.....
Do.....	114	9011	.....	Do.....	142	1224	.....
Do..... (operating Baltimore, Pittsburgh and Chicago R. R.).....	145	9011	21019	Do.....	234	1223	.....
Do.....	35	9051	.....	Do.....	311	1802	.....
Do.....	46	9051	.....	Do.....	311	1803	.....
Baltimore and Potomac.....	11	3514	.....	Delaware, Lackawanna and Western.....	97	2122	7022
Do.....	16	3514	.....	Detroit, El River and Illinois.....	219	22056	22027
Bath and Hammondsport.....	258	1810	.....	East Alabama and Cincinnati.....	330	6614	17014
Baton Rouge, Grosse Tête and Opelousas.....	346	8003	30005	Eastern Ohio. (See W. H. and C. B. Stevens.).....	.....	.....	.....
Bell's Gap (See Philadelphia and Reading.).....	276	2492	.....	East Tennessee, Virginia and Georgia.....	53	19002	19002
Berkshire County. (See Philadelphia and Reading.).....	.....	.....	.....	Do.....	78	19002	19002
Boston and Albany. (lessees North Bloomfield R. R.).....	260	755	.....	Emmittsburg.....	268	3520	.....
Breakwater and Frankford.....	242	3406	9306	Erie.....	20	1901	.....
Buffalo and Jamestown.....	179	1290	.....	Do.....	79	1208	.....
Cairo and Saint Louis.....	209	23053	.....	Erie and Pittsburgh.....	82	2445	.....
Carolina Central.....	277	13003	13003	Evansville and Crawfordville.....	111	22012	22012
Cayuga.....	183	1284	.....	Evansville, Terre Haute and Chicago.....	222	22023	22024
Central, of Minnesota.....	326	26017	.....	Fall River.....	270	754	.....
Central, of New Jersey.....	69	2101	7001	Flushing, North Side and Central.....	264	1906	.....
Do.....	158	2258	7003	Do.....	250	1296	.....
Central Ohio.....	28	9001	21001	Do.....	257	1296	.....
Do.....	112	9001	21001	Fort Scott, Southeastern and Memphis.....	333	33014	.....
Central Pacific.....	18	46001	.....	Fort Wayne, Jackson and Saginaw.....	157	24008	.....
Central Railroad and Banking Company.....	123	15012	15012	Do.....	240	24008	.....
Do.....	155	15010	15010	Fort Wayne, Muncie and Cincinnati.....	226	22019	22020
Do.....	162	15005	15005	Frankfort and Kokomo.....	313	22032	22033
Charlotte, Columbia and Augusta.....	101	13007	13007	Galena and Southern Wisconsin.....	261	22025	.....
Cheraw and Darlington.....	237	5608	14006	Georgia.....	68	6001	13004
Do.....	290	14006	14006	Do.....	70	13004	13004
Chicago and Canada Southern.....	251	24036	.....	Do.....	176	6006	15007
Chicago and Iowa.....	109	1913	23036	.....	.....	.....	.....
Chicago and Pacific.....	300	23054	.....	.....	.....	.....	.....
Chicago and Paducah.....	254	23043	.....	.....	.....	.....	.....
Chicago, Burlington and Quincy.....	50	23010	.....	.....	.....	.....	.....
Do.....	110	27011	.....	.....	.....	.....	.....
Do.....	134	27011	.....	.....	.....	.....	.....
Chicago, Cincinnati and Louisville.....	215	22014	22015	.....	.....	.....	.....
Chicago, Rock Island and Pacific.....	243	27016	.....	.....	.....	.....	.....
Chippewa Falls and Western.....	245	25028	.....	.....	.....	.....	.....
Cincinnati, Hamilton and Dayton.....	59	9030	21026	.....	.....	.....	.....
Do.....	75	9030	21026	.....	.....	.....	.....

## Index to Table F—Continued.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Georgia.....	211	15007	15007	Maryland and Delaware.....	218	3403	9503
Grand Rapids and Indiana.....	196	22020	22021	Mayeville and Lexington.....	194	20016	20016
Greenville and Columbia.....	199	5602	14001	Memphis and Charleston.....	108	17005	17005
Do.....	212	14001	14001	Do.....	306	17005	17005
Do.....	265	5602	14001	Mississippi and Tennessee.....	169	18002	18002
Do.....	267	5602	14001	Do.....	171	7002	18002
Do.....	297	14009	14009	Mississippi Central. (See New Orleans, Saint Louis and Chicago.)			
Hannibal and Saint Joseph.....	107	28030		Missouri, Kansas and Texas.....	52	28011	.....
Houston and Texas Central.....	84	8503	31003	Do.....	56	28014	.....
Do.....	117	8505	31004	Mobile and Girard.....	322	17008	17008
Do.....	138	8577a	31005	Mobile and Montgomery.....	96	17012	17012
Illinois Midland.....	252	23048		Mobile and Ohio.....	127	7004	18004
Indianapolis and Saint Louis.....	57	23028		Do.....	201	18004	18004
Indianapolis and Vincennes.....	207	22001	22001	Do.....	249	7004	18004
Indianapolis, Bloomington and Western.....	256	23039		Do.....	303	6611	17011
Do.....	296	23039		Do.....	333	7007	18007
Indianapolis, Cincinnati and La Fayette.....	33	22003	22003	Montgomery and Eufaula.....	286	17003	17003
Do.....	34	22005	22005	Montpeller and Wells River.....	152	528	
Indianapolis, Peru and Chicago.....	146	23004	22004	Morris and Essex.....	81	2106	7013
Jacksonville, Pensacola and Mobile.....	139	18002	18002	Do.....	192	2106	
Do.....	345	18002	18002	Nashville and Chattanooga.....	73	19004	19004
Jeffersonville, Madison and Indianapolis.....	83	22007	22007	Do.....	135	19007	19007
Do.....	213	22006	22006	Newark and Bloomfield.....	253	2124	.....
Do.....	294	22011	22011	Newark, Somerset and Straitsville.....	334	9042	21038
Kent County.....	238	3513	10012	Newcastle and Franklin.....	264	2500	.....
Kentucky Central.....	100	20002	20002	New Jersey and New York.....	327	2120	.....
Do.....	185	20002	20002	New Orleans, Mobile and Texas.....	77	17013	17013
Knoxville and Ohio.....	314	19011	19011	New Orleans, Saint Louis and Chicago.....	65	18001	18001
Lake Erie and Louisville.....	281	9024	21020	Do., (operating Mississippi Central.)	325	7009	18009
Lake Shore and Michigan Southern.....	2	1241	.....	Newport and Wickford Railroad and Steamboat Company.....	200	825	.....
Do.....	3	1241	.....	New York Central and Hudson River.....	1	1217	.....
Do.....	6	9008	21007	Do.....	4	1211	.....
Do.....	7	1241	.....	Do.....	71	1211	.....
Do.....	8	9049	21045	Do.....	233	1811	.....
Do.....	47	1241	.....	Northeastern.....	76	14005	14005
Do.....	48	1241	.....	Do.....	94	5607	14005
Lexington and Big Sandy.....	342	9605	20001	North and South.....	340	15024	15024
Little Rock and Fort Smith.....	124	22005		Northern Central.....	85	1255	.....
Logansport, Crawfordsville and Southwestern.....	262	22027	22028	Do.....	332	3519	.....
Long Island.....	153	1234	.....	North Pacific Coast.....	255	46016	.....
Do.....	223	1806	.....	Northwestern North Carolina.....	237	13012	13012
Louisville and Nashville.....	29	20005	20005	Ohio and Mississippi.....	40	22010	22010
Do.....	41	20008	20008	Do.....	93	22018	22019
Do.....	42	19009	19009	Ohio and Toledo.....	307	9010	21009
Do.....	43	19010	19010	Oregon Central.....	263	44002	.....
Do.....	74	19010	19010	Painesville and Youngstown.....	224	9050	21046
Do.....	92	19006	19006	Paris and Danville.....	231	23050	.....
Do.....	104	19006	19006	Peach Bottom.....	259	2496	8094
Do.....	154	20007	20007	Do.....	331	2498	.....
Do.....	214	20007	20007	Pennsborough and Harrisville.....	272	12005	.....
Do.....	315	20006	20006	Pennsylvania.....	5	2103	7004
Do.....	318	20007	20007	Do.....	9	2401	8001
Louisville, Cincinnati and Lexington.....	45	20004	20004	Do.....	12	2401	.....
Do.....	53	20018	20018	Do.....	118	2103	.....
Do.....	133	20003	20003	Do.....	275	2493	.....
Do.....	241	9786a	20013	Do.....	305	2489	.....
Do.....	279	20017	20017	Do.....	323	2118	.....
Louisville, New Albany and Chicago.....	167	22008	22008	Pennsylvania Co.....	168	9047	21043
Louisville, Paducah and Southwestern.....	160	20011	20011	Pensacola and Louisville.....	312	16003	16003
McKean and Buffalo.....	309	2495a	.....	Peoria, Pekin and Jacksonville.....	183	23038	.....
Macon and Brunswick.....	170	6012	15013	Philadelphia and Reading, (leaves Berks County Railroad).....	304	2494	.....
Do.....	187	15013	15013	Pittsburgh and Castle Shannon.....	343	2499	.....
Do.....	328	6012	15013	Pittsburgh, Cincinnati and Saint Louis.....	13	9036	21032
Macon and Western.....	98	6011	15012	Do.....	19	9031	21037
Marietta and Cincinnati.....	31	9032	21028	Do.....	147	22009	22009
Do.....	126	9030	21018	Do.....	159	22013	22014
Do.....	175	9033	21049	Do.....	203	9012	21011
Do.....	287	9019	21017	Do.....	208	9033	21029
Do.....	319	9054	21050				

## Index to Table F—Continued.

Title.	Order.	Number of route.	New number of route.	Title.	Order.	Number of route.	New number of route.
Pittsburgh, Cincinnati and Saint Louis .....	225	22016	22017	Southwestern .....	164	15011	15011
Do .....	236	9034	21030	Do .....	173	15016	15016
Pittsburgh, Fort Wayne and Chicago .....	38	9002	.....	Do .....	174	15016	15016
Do .....	44	9002	.....	Do .....	273	6088	15017*
Do .....	51	9002	.....	Do .....	336	15017	15017
Do .....	66	2429	.....	Stevens, W. H. and C. B. proprietors Eastern Ohio Railroad .....	269	9052	21043
Do .....	105	2429	.....	Sullivan and Erie Coal and Railroad Company .....	301	2461	8061
Do .....	222	9039	.....	Terre Haute and Indianapolis .....	22	22002	22002
Do .....	292	9039	21035	Do .....	24	23031	.....
Port Royal .....	235	14010	14010	Texas, Mississippi River and Northwestern .....	341	7525a	22003
Raleigh and Augusta Air Line .....	229	13010	13010	Do .....	344	7645a	22004
Raleigh and Gaston .....	195	13001	13001	Toledo, Canada Southern and Detroit .....	102	24035	.....
Reading and Columbia .....	280	2431	8031	Do .....	115	24035	.....
Rhinebeck and Connecticut .....	247	1812	.....	Union Pacific .....	15	34001	.....
Richmond and Danville .....	87	13004	13004	Utah Northern .....	150	41003	.....
Do .....	161	13004	13004	Utah Southern .....	180	41002	.....
Richmond and Petersburg .....	36	4409	11008	Do .....	230	41002	.....
Rome, Watertown and Ogdensburg .....	210	1287	.....	Utica and Black River .....	144	1288	.....
Saint Louis and Southeastern .....	125	23032	.....	Do .....	205	1288	.....
Do .....	149	19008	19008	Do .....	262	1288	.....
Do .....	165	20010	20010	Vaca Valley .....	266	46015	.....
Do .....	308	23032	.....	Vicksburg and Brunswick .....	335	17021	17021
Saint Louis, Rock Island and Chicago .....	151	23005	.....	Vicksburg and Meridian .....	172	18003	18003
San Francisco and North Pacific .....	139	46011	.....	Do .....	285	18003	18003
Do .....	140	46011	.....	Virginia and Truckee .....	131	16419	45001
Savannah and Charleston .....	89	14004	14004	West End Narrow Gauge .....	339	28031	.....
Savannah and Memphis .....	320	17016	17016	Western .....	274	5216	13011
Savannah, Griffin and North Alabama .....	299	6146	15022	Western Maryland .....	166	3507	10006
Seaboard and Roanoke .....	197	4415	11015	Western North Carolina .....	206	5006	13006
Selma and Gulf .....	316	17017	17017	Do .....	229	13006	13006
Do .....	324	6617	17017	Western, of Alabama .....	63	17001	17001
Selma, Rome and Dalton .....	143	6610	17010	Do .....	282	17002	17002
Do .....	217	17010	17010	West Jersey .....	136	2111	7019
Shelby .....	293	20013	20013	Do .....	220	2112	7020
Somerset .....	239	931	.....	Do .....	291	2113	7021
South and North Alabama .....	216	17004	17004	West Wisconsin .....	191	25014	.....
South Carolina .....	156	14003	14003	White Water Valley .....	181	9035	21031
Do .....	177	14003	14003	Wilmington and Weldon .....	60	13002	13002
Do .....	178	14003	14003	Wilmington, Columbia and Augusta .....	67	14002	14002
Do .....	317	14003	14003	Do .....	130	14002	14002
Southern, of Long Island .....	244	1295	.....	Woodstock .....	242	532	.....
Southern Pacific .....	191	46017	.....	Worcester .....	246	3517	.....

G.—Statement of the number, description, and prices of mail-bags, mail-bag-catchers, mail locks and keys purchased, and of the expense incurred on account thereof during the fiscal year ended June 30, 1876, viz :

Number.	Description.	Size.	Price.	Cost.	Aggregate.
200	Leather mail-pouches.....	No. 1	\$6 56	\$1,312 00	
400	do.....	No. 2	5 16	2,064 00	
600	do.....	No. 3	4 40	2,640 00	
600	do.....	No. 4	3 48	2,088 00	
500	do.....	No. 5	2 56	1,280 00	
2	do.....	No. 1	6 50	13 00	
3,202	do.....	No. 2	5 70	18,151 40	
4,602	do.....	No. 3	4 75	21,859 50	
3,702	do.....	No. 4	3 80	14,167 60	
2,602	do.....	No. 5	2 70	7,025 40	
	Royalty of patent 14,110 leather pouches.....		10	1,411 00	
16,410					\$72,011 90
400	Leather horse-mail-bags.....	No. 1	6 60	2,640 00	
500	do.....	No. 2	5 60	2,800 00	
200	do.....	No. 3	5 10	1,020 00	
1,100					6,460 00
202	Canvas (through registered) mail-pouches.....	No. 1	8 00	1,616 00	
1,602	do.....	No. 3	5 45	9,220 90	
3,300	Canvas mail-catcher pouches.....		4 25	14,025 00	
5,304					14,025 00
45,000	Jute canvas mail-sacks.....	No. 1	78	35,100 00	
3,456	do.....	No. 1	50	2,724 00	
11,000	do.....	No. 2	52	5,720 00	
3,403	do.....	No. 2	40	1,361 20	
3,500	do.....	No. 3	15	525 00	
626	do.....	No. 3	14	87 64	
62,925					45,521 84
5,000	Cotton canvas mail-sacks.....	No. 1	1 32	6,600 00	
1,500	do.....	No. 2	1 02	1,530 00	
2,500	do.....	No. 3	21	525 00	
495	do.....	No. 3	62	306 90	
12,500	do.....	No. 3	38	950 00	
11,995					9,911 90
	Repairs of mail-bags of every description.....			30,161 92	
	Advertised samples and miscellaneous expenses incident to mail-bags.....			2,065 30	
87,585	Printed wooden tags.....	11-16 c.		602 15	
142,445	do.....	11-16		979 30	
2,900	do.....	24		55 00	
600	do.....	13-16		7 12	
18,100	do.....	4		90 50	
250,930					1,734 07
35,000	Mail-bag label-cases.....		12	4,200 00	
650	Mail-bag-catchers.....		15 00	9,750 00	
300	Sockets for mail-bag-catchers.....		40	120 00	
20	Elongated sockets for mail-bag-catchers.....		70	14 00	
200	Handles for mail-bag-catchers.....		40	80 00	
18	Springs for mail-bag-catchers.....		60	10 80	
	Personal service for mail-bag-catchers.....			1,174 96	
	Repairs of mail-bag-catchers.....			168 90	
					11,318 66
	Total expense of mail-bags and mail-catchers.....				206,847 40
	MAIL LOCKS AND KEYS.				
9,625	Brass mail-locks for street letter-boxes.....		1 25	12,031 25	
250	Steel keys for street letter-boxes.....		15	37 50	
20	Brass safety key-chains.....		864	17 30	
500	Brass mail-locks for registered through mails.....		1 75	875 00	
	Repairs of 12,533 mail-locks.....			3,759 90	
					12,961 05
	Total expense of mail locks and keys.....				3,759 90
					16,720 95

\* Red striped. † Black striped.

THOS. J. BRADY.  
Second Assistant Postmaster-General.

H.—Railway post-office lines in the United States June 30, 1876, showing the increase in the service since June 30, 1875.

Terminal points.	Miles of route.	Miles of service.	Service each way.	Number of clerks.			Increase of miles of route from June 30, 1875, to June 30, 1876.	Increase of miles of service from June 30, 1875, to June 30, 1876.	Increase in num-ber of clerks from June 30, 1875, to June 30, 1876.			Increase in lines of railway post-offices from June 30, 1875, to June 30, 1876.
				Number of clerks.								
				\$1,400.	\$1,200.	\$1,000.						
Albany to Buffalo, N. Y.	998	1,192	Twice daily.	12	10	20				2	12	
Atlanta to Augusta, Ga.	171	342	Daily.		4				(a)	(a)		
Baltimore, Md., to Canandaigua, N. Y.	325	650	do.	3	2	5			2	4	(d)	
Baltimore, Md., to Grafton, W. Va.	280	1,120	Twice daily.	10	8	3			4	4	(d)	
Bangor to Vanceboro, Me.	118	236	Daily.	4	4	4				(a)	1	
Bloomington, Ill., to Mexico, Mo.	200	400	do.	2	3	3				(a)	2	
Boston, Mass., to Portland, Me.	116	232	do.	4	3	3						
Boston, Mass., to Saint Albans, Vt.	250	500	do.	4	8							
Boston, Mass., to Albany, N. Y.	200	800	Twice daily.	12	4	12			2	(d)	4	
Boston to Weymouth, Mass.	122	244	Daily.		6							
Boston to Fitchburg, Mass.	50	100	do.			1						
Boston, Mass., to Bangor, Me.	249	996	Twice daily.	11	13							
Bristol to Chattanooga, Tenn.	242	484	Daily.	4	2	2			(f)			
Buffalo, N. Y., to Toledo, Ohio.	285	1,140	Twice daily.	14	20	27			2	2	5	
Burlington to Council Bluffs, Iowa	291	582	Daily.	4	4	4						
Calro to Centralia, Ill.	112	224	do.	3	5	1			1		1	
Chattanooga, Tenn., to Atlanta, Ga.	140	280	do.	4	4	4			1	1		
Chicago, Ill., to Fort Howard, Wis.	242	484	do.	4	11	1			1	1		
Chicago, Ill., to Toledo, Ohio.	243	972	Twice daily.	14	19	20			5	3	9	
Chicago to Quincy, Ill.	983	596	Daily.	6	13	2			2	2	2	
Chicago to Freeport, Ill.	131	262	do.	3	4							
Chicago, Ill., to Cincinnati, Ohio.	310	620	do.	5	8	3			1	1	12	
Chicago, Ill., to Iowa City, Iowa.	237	474	do.	5	6				(a)	1		
Chicago, Ill., to Cedar Rapids, Iowa.	219	438	do.	5	6				1			
Chicago to Centralia, Ill.	258	516	do.	3	6				1	(a)	3	
Chicago, Ill., to Saint Louis, Mo.	290	580	do.	7	8				1	(a)		
Cleveland to Cincinnati, Ohio.	244	488	do.	5	6	1			1	(a)	1	
Cincinnati, Ohio, to Indianapolis, Ind.	262	524	do.	4	6				1			
Cincinnati, Ohio, to Saint Louis, Mo.	340	680	do.	3	14				(a)	4		
Cincinnati to Council Bluffs, Iowa.	330	700	do.	3	4							
Davenport to Council Bluffs, Iowa.	307	614	do.	4	7				1			
Detroit, Mich., to Chicago, Ill.	284	568	do.	4	3	1			1	(a)	1	
Dubuque to Fort Dodge, Iowa.	214	428	do.	4	2				1	(a)		
Dubuque, Iowa, to Centralia, Ill.	345	690	do.	6	5				1			
Grafton, W. Va., to Cincinnati, Ohio.	309	1,236	Twice daily.	5	8	1			1			
Grafton, W. Va., to Chicago, Ill.	559	1,118	Daily.	9	7	3			4	(c)	3	
Indianapolis, Ind., to Saint Louis, Mo.	291	582	do.	4	5							

Indianapolis, Ind., to Galesburgh, Ill.	364	do	7		(a)	
Kansas City, Mo., to Council Bluffs, Iowa	526	do	12	1		1
La Fayette, Ind., to Quincy, Ill.	973	do	5			
Louisville, Ky., to Nashville, Tenn.	546	do	7			
Lynchburgh, Va., to Bristol, Tenn.	370	do	9		2	4
Louisville, Ky., to Milan, Tenn.	491	do	4			(a)
Milwaukee, Wis., to Saint Paul, Minn.	568	do	3	244	568	3
New Orleans, La., to Cairo, Ill.	324	do	8			1
New York, N. Y., to Boston, Mass.	548	do	13			
New York, N. Y., to Washington, D. C.	1,096	do	11			1
New York, N. Y., to Buffalo, N. Y.	938	Twice daily	18			2
New York to Albany, N. Y.	928	do	14	8		6
New York to Buffalo, N. Y.	422	do	13	16	(b)	2
New York to Albany, N. Y.	576	do	6	4		1
Omaha, Neb., to Ogden, Utah.	144	do	4	6		(a)
Philadelphia, to Pittsburgh, Pa.	1,032	Daily	15	20		1
Peoria, Ill., to Burlington, Iowa	358	do	7	5		18
Pittsburgh, Pa., to Saint Louis, Mo.	43	do	1	23		
Pittsburgh, Pa., to Cincinnati, Ohio	1,240	do	6	15	1,240	8
Quincy, Ill., to Kansas City, Mo.	640	do	6	5	313	5
Quincy, Ill., to Denison, Tex.	313	Daily	4		628	6
Recheater to Niagara Falls, N. Y.	261	do	10			(a)
San Francisco, Cal., to Ogden, Utah	593	do	3			(e)
Saint Louis, Mo., to Atchison, Kans.	1,186	do	4			
Saint Louis, Mo., to Toledon, Kans.	77	do	12	2		(a)
Toledo, Ohio, to La Fayette, Ind.	841	do	15			2
Washington, D. C., to Weldon, N. C.	330	do	7			1
Washington, D. C., to Lynchburgh, Va.	903	do	4	9		(c)
Hornellsville to Dunkirk, N. Y.	216	Twice daily	13	5		3
	178	Daily	4	1		(e)
	256	do	3			
	128	do	4			

## Recapitulation and comparative statement of the service of June 30, 1875, and June 30, 1876, showing the increase.

	June 30, 1875.	June 30, 1876.	Increase.
Number of lines of railway post-offices.....	63	63	1
Aggregate number of miles of the above.....	16,932	17,713	781
Number of miles of actual service performed daily.....	40,109	41,671	1,562
Number of miles of actual service performed annually.....	14,639,765	15,209,915	570,130
Number of head clerks at \$1,400 per annum.....	396	361	35
Number of clerks at \$1,200 per annum.....	457	463	6
Number of assistant clerks at \$1,000 per annum.....	117	216	99
Number of assistant clerks at \$800 per annum.....	...	1	1
Number of assistant clerks at \$540 per annum.....	1	1	...
Number of assistant clerks at \$540 per annum.....	901	1,043	141
Making total number of clerks.....	\$1,192,640	\$1,278,340	\$155,700
With an annual compensation amounting to.....			

<sup>a</sup> Reduction of one. <sup>b</sup> Reduction of two. <sup>c</sup> Reduction of three. <sup>d</sup> Reduction of four. <sup>e</sup> Reduction of five. <sup>f</sup> Reduction of 14.

<sup>g</sup> Distance from Peoria to Galesburgh, included in Indianapolis, Ind., to Galesburgh, Ill.

<sup>h</sup> Number of clerks included in New York to Buffalo, N. Y.

NOTE.—Since last report the following railway post-office lines have been discontinued, viz: Cincinnati, Ohio, to Louisville, Ky., having a force of six clerks; Memphis to Chattanooga, Tenn., having a force of six clerks and six head clerks.

THOS. J. BRADY,  
Second Assistant Postmaster-General.

POST-OFFICE DEPARTMENT,  
OFFICE GENERAL SUPERINTENDENT RAILWAY MAIL SERVICE,  
Washington, D. C., October 27, 1876.

SIR: During the year ending June 30, 1876, there were employed in the distribution, delivery, and transfer of the mails upon and between railroad and steamboat routes 1,042 railway post-office clerks, at an annual compensation of \$1,278,340, an increase of 13.87 per cent. over the preceding year, and an average salary of \$1,226 per annum; 1,017 route-agents, at an annual compensation of \$975,280, an increase of 3.33 per cent. over the preceding year, and an average salary of \$958 per annum; 219 mail-route messengers, at an annual compensation of \$145,610, a decrease of 1.22 per cent. under the preceding year, and an average salary of \$665 per annum; and 137 local agents, at an annual compensation of \$104,910, an increase of 8.62 per cent. over the preceding year, and an average salary of \$765 per annum. The percentage of increase in the expenses of the different classes of service for the year ending June 30, 1875, over that of the year ending June 30, 1874, were as follows:

	Per cent.
Railway post-office clerks .....	6.09
Route-agents .....	5.25
Mail-route messengers .....	8.00
Local agents .....	1.97

The cause of the much greater increase of compensation to railway post-office clerks for the year ending June 30, 1876, over that of the year ending June 30, 1875, was the extension of the service over lines of railroad that had heretofore declined to furnish proper facilities for the service, and the establishing of the fast railway post-office service between New York and Chicago, and New York, Saint Louis, and Cincinnati. The increase of expenses for clerical force necessitated by this extension was in a measure offset by the reduction in force on or entire discontinuance of other lines.

The table accompanying, which gives in detail the number of clerks, &c., upon the different lines of railway post-offices, will not show all the decrease on different lines, as transfers were made to a great extent by detail as actual experience made them possible.

The placing of railway post-office service upon new lines, taking the place of and performing the work of route-agents and mail-messenger service, materially lessened the increase of expense for route-agent service, and actually decreased the expense of mail-messenger service, while the establishing of new lines of service, rendering an increase in the number of local agents necessary at the principal junctions, caused the increase of 8.62 per cent. for the year ending June 30, 1876, as against 1.97 per cent. for the year ending June 30, 1875.

*Appropriations for 1877 and estimates for 1878.*

RAILWAY POST-OFFICE CLERKS.

The appropriation for the salaries of railway post-office clerks for the year ending June 30, 1877, is \$1,225,000, as against an expense for the year ending June 30, 1876, of \$1,278,340. This material decrease made it necessary to reduce both salaries and force. Head railway post-office clerk's salaries were reduced from \$1,400 to \$1,300 per annum. Railway post-office clerks were reduced from \$1,200 to \$1,150 per annum. Assistant clerks were left at the old rate, \$1,000 per annum, and at the



same time considerable reductions were made in force. This latter was possible on account of the withdrawal of our best postal-car facilities from the New York Central and Hudson River Railroad, Lake Shore and Michigan Southern Railroad, Pennsylvania Railroad and its connections.

In making estimates for the year ending June 30, 1878, the strong probabilities of the restoration of this service should be considered.

It is also due to the class of officers who perform this work of distribution of mail upon the railroads that the nature of their duties, the expense involved by absence from home, the risk and dangers continually attending them, should be considered in adjusting the salaries.

A railway post-office clerk travels on the cars, on an average, a distance of 131 miles daily, which at least consumes an average of 5 hours, is called upon to be on duty from 2 to 5 hours before the starting-time of his train, and is oftentimes on duty an hour or more after the arrival of his train at destination, making his daily average time on duty never less than 7 hours, and averaging 8 or 9. The work he is called upon to perform is different in every respect from any other labor on railroads, requiring him, as it does, to be constantly on his feet while the train is in motion. "The time during which almost every other class of railroad-employed is at rest." So that, in addition to his work as distributing-clerk, which is of itself sufficiently hard and tiresome when followed closely the day through, the exertion to maintain his perpendicular while the train is in motion intensifies the effect of continual jar upon the system; and experience shows that there are but few clerks who have been continually employed in this service for five years or over that do not feel very seriously the effect, and in very many cases have been forced to abandon their occupation on account of breaking down.

The railway post-office clerk when on duty is absent from home traveling and on expense, which is additional in every respect. This expense in England is commuted to the "traveling sorters," as his duty calls him from home at least half of the time, his salary is reduced from \$150 to \$200 annually. In addition, the head railway post-office clerk furnishes, at his own expense, all the stationery, &c., necessary to perform his work, which is a considerable item. It will be thus seen that the average pay of \$1,226 per annum nets the clerk little over \$1,000 per annum.

For these reasons, the estimates for the year ending June 30, 1878, should be made upon the basis of the old salary, \$1,400 for head clerks, \$1,200 for clerks, and \$1,000 for assistant clerks, and allowing for a small increase to allow the extensions of the service, in case the railroads grant the necessary facilities. An increase of 6 per cent. over the expense of the year ending June 30, 1876, will be adequate. The estimate for the salaries of railway post-office clerks for the year ending June 30, 1878, will therefore be \$1,355,040.

#### ROUTE-AGENTS.

The appropriation for the salaries of route-agents for the year ending June 30, 1877, is \$972,500, as against an expense of \$975,280 for the year ending June 30, 1876. In order that the expense for the fiscal year ending June 30, 1877, might be brought within the appropriation, the pay for route-agents was reduced according to the following scale:

A route-agent making a daily average run of 90 miles receives \$900 per annum, with \$20 per annum additional compensation to \$900 per annum for each additional 10 miles per day to the daily average of 90

miles per day, up to a daily average of 140 miles per day, for which he receives \$1,000 per annum, without increase of compensation for increase of daily average miles run.

Prior to June 30, 1876, the compensation to route-agents had been increased \$30 per annum for each additional 10 miles to their daily average run over 90 miles per day to a sum not exceeding \$1,080 per annum.

As the same statement, to a modified extent, regarding their expenses, risk, and work, which was made of railway post-office clerks, and at the old rates, their average pay only being \$958 per annum, ranging from \$900 to \$1,200 per annum, the estimates for the year ending June 30, 1878, should be made upon the old basis. As the railway post-office service will displace this service to a great extent, an increase of 2 per cent. over the estimate for the fiscal year ending June 30, 1877, will be sufficient.

The estimates for the salaries of route-agents for the fiscal year ending June 30, 1878, will therefore be \$1,071,000.

#### MAIL-ROUTE MESSENGERS.

The appropriation for the salaries of this class of employes for the fiscal year ending June 30, 1877, is \$153,500. As these employes perform the work on short lines at a comparatively low salary, where otherwise route-agents, at a salary of at least \$900 per annum, would be employed, an increase on the appropriation of the present year is necessary. An increase of 5 per cent. on the appropriation for the fiscal year ending June 30, 1877, will be ample.

In connection with these estimates the revival of railroad building should be considered, as it has a very important influence upon the expense of this class of service.

The estimate for the salaries of *mail-route messengers* for the fiscal year ending June 30, 1878, is therefore \$161,175.

#### LOCAL AGENTS.

The appropriations for the salaries of local agents for the fiscal year ending June 30, 1877, is \$109,000, as against an expense of \$104,910 for the year ending June 30, 1876.

The great increase in the bulk of mail-matter, the improvement each year in railroad connections, and the importance of the mail-transfers made under the charge of this class of offices call for an increase in this class of employes. An increase of 5 per cent. over the appropriation for the year ending June 30, 1877, will be ample.

The estimate for the salaries of the local agents for the year ending June 30, 1878, will therefore be \$114,450.

During the past year negotiations for the establishing of a fast-mail service were brought to a successful close, and on September 16, 1875, an exclusive postal-car train was started upon the New York Central and Hudson River and Lake Shore and Michigan Southern Railroads, between New York and Chicago, via Albany, Buffalo, Cleveland, and Toledo. Postal-car lines were also started between New York, Saint Louis, and Cincinnati, over the Pennsylvania Railway and its connections, via Philadelphia, Pittsburgh, Columbus, and Indianapolis. These were run at a high rate of speed, and made connections at all important junctions with the regular trains to and from all parts of the country, advancing the mails between the different sections from twelve to twenty-four and forty-eight hours.

The inauguration of these trains was as important a step on the improvement of the interior mail system as the inauguration of the railway post-office service itself. It was established as an experiment, but so fully did it accomplish all that was expected, and so much more, that it is greatly to be deplored that it could not have been continued. Though withdrawn July 22, 1876, it was in operation sufficiently long to thoroughly establish itself in the confidence of the business public.

Since the close of the last fiscal year, the action of the trunk lines of railroads over which the fast-mail service was in operation, not only by the withdrawal of the fast-mail service, but the most important lines of railway post-offices on other trains, and the denial of the use of some of the best trains, even for the forwarding of ordinary closed mails, has greatly embarrassed this service, and it is only by the utmost exertion on the part of the officers in charge that serious confusion does not result.

It is greatly to be hoped that Congress will, during the approaching session, take such action in regard to compensation for mail transportation on railroad routes as will obtain the best possible facilities, not only for railway post-office service, but for the forwarding of mails in bulk on all trains that may be run on any road. A continuance of the present delays and irregularities resulting from deficient accommodations on railroad lines cannot but affect disastrously all business interests.

Up to the time of the discontinuance of the fast-mail service and its accompanying lines of post-office cars on other trains, the great bulk of mails forwarded by railroad routes was distributed and arranged for final delivery while in transit.

The following statement of the number of packages of letters and sacks of papers that were distributed on the fast-mail line for six months ending April 30th, 1876, will give some idea of the immense work performed on the cars.

TABLE A.—*Report of mails distributed in New York and Chicago, ("the Fast Mail,") Buffalo and Toledo, and Toledo and Chicago railway post-offices, for six months ending April 30, 1876.*

## MONTHLY TOTALS.

Date.	Papers.		Letters.		No. rega. in transit.
	Number of sacks.	Number of pieces.	Number of packages.	Number of letters.	
November, 1875 .....	29, 024	5, 804, 800	146, 160	8, 769, 600	.....
December, 1875 .....	31, 736	6, 345, 900	156, 976	9, 418, 560	.....
January, 1876 .....	31, 384	6, 376, 800	163, 689	9, 891, 340	.....
February, 1876 .....	31, 156	6, 231, 900	158, 451	9, 507, 060	37, 649
March, 1876 .....	34, 670	6, 935, 800	175, 334	10, 570, 040	45, 014
April, 1876 .....	33, 708	6, 741, 600	164, 882	9, 892, 920	44, 358
Total .....	191, 668	38, 335, 400	965, 492	57, 979, 520	126, 921

TABLE A.—*Report of mails distributed, &c.*—Continued.

## MONTHLY TOTALS ARRANGED BY STATES.

Month.	Number of paper sacks.									
	New England.	New York.	New Jersey.	Pennsylvania.	Ohio.	Michigan.	Indiana.	Illinois.	Iowa.	Wisconsin.
November .....	1, 679	2, 649	95	651	3, 134	2, 490	1, 660	2, 573	2, 070	1, 193
December .....	1, 816	2, 296	113	623	3, 331	2, 886	1, 819	2, 890	2, 434	1, 466
January .....	1, 650	2, 249	131	732	3, 201	2, 892	1, 798	2, 721	2, 219	1, 318
February .....	1, 707	2, 560	130	679	2, 989	2, 754	1, 631	2, 613	2, 225	1, 347
March .....	1, 494	2, 450	64	762	3, 506	3, 299	2, 026	2, 534	2, 604	1, 452
April .....	1, 643	4, 192	51	758	3, 137	2, 808	1, 807	2, 929	2, 365	1, 359
Total .....	9, 989	18, 996	584	4, 205	19, 298	17, 129	10, 741	16, 660	13, 947	8, 155

Month.	Missouri.	Kansas.	Minnesota.	Nebraska.	Dakota.	Colorado.	Territories.	Mixed.	Local.	Estimated.
November .....	849	619	23	451	138	.....	63	2,760	5,697	133
December .....	963	689	22	533	134	.....	682	2,647	4,787	632
January .....	949	767	21	519	200	.....	993	2,239	4,463	567
February .....	1,053	840	.....	520	204	.....	1,352	2,054	4,650	821
March .....	1,985	910	.....	651	68	179	1,129	2,945	4,284	737
April .....	1,904	842	20	667	190	203	1,105	2,525	2,178	1,685
Total .....	6,303	4,667	92	3,341	864	382	5,330	19,080	26,999	4,641

Month.	Number of letter-packages.									
	New England.	New York.	New Jersey.	Pennsylvania.	Ohio.	Michigan.	Indiana.	Illinois.	Iowa.	Wisconsin.
November .....	14,258	23,337	1,463	8,241	16,870	13,702	8,903	10,519	7,253	5,903
December .....	16,328	24,494	2,195	8,360	20,666	14,128	10,081	10,223	7,666	6,116
January .....	18,329	23,774	2,479	8,383	18,984	14,638	9,213	10,169	8,078	7,390
February .....	18,148	21,837	2,259	7,117	20,063	13,750	9,719	9,769	8,306	6,113
March .....	20,584	25,896	2,373	9,367	23,025	15,223	10,316	10,886	8,787	6,051
April .....	20,708	25,725	2,422	8,184	20,570	14,440	9,973	9,802	8,113	6,238
Total .....	108,355	145,063	13,191	49,652	120,178	85,941	58,205	61,177	48,203	37,811

Month.	Missouri.	Kansas.	Minnesota.	Nebraska.	Dakota.	Colorado.	Territories.	Mixed.	Local.	Estimated.
November .....	1,762	1,205	1,687	1,689	423	.....	1,041	15,941	11,496	356
December .....	1,963	1,373	2,150	1,843	456	.....	1,148	15,665	10,714	1,147
January .....	2,261	1,716	2,976	1,722	551	.....	1,792	16,221	13,298	1,013
February .....	2,033	1,731	3,160	2,100	693	.....	1,973	16,164	11,815	2,368
March .....	2,110	2,008	3,555	2,214	352	707	681	19,089	11,059	991
April .....	2,223	1,941	3,415	2,316	413	1,330	245	17,441	8,299	1,225
Total .....	12,352	9,974	16,943	11,884	2,818	2,037	6,180	101,121	66,611	7,170

By this it will be seen that 965,492 packages, containing 57,979,520 letters, and 191,668 sacks, containing 38,335,400 packages of papers and other miscellaneous matter, 96,314,920 separate pieces of mail matter in all, giving an average of 529,200 pieces handled daily. This was in addition to the through mail or mails made up for direct exchange in pouches, between the different large cities, and the mail in transit for final distribution upon lines beyond. These figures are obtained from a record kept of each day's work.

Upon each package of mail made up on any postal or route agent's line for final delivery on any other postal or route agent's route to offices local to such route, or for final distribution in any post-office, is placed a slip bearing the post-mark of the route, date, and name of the clerk or agent making the distribution. The clerk, agent, or office receiving this package notes all errors, if any, upon this slip, and certifies to the same. If no errors are made it is marked "O. K.," and returned to the division superintendent. These errors are entered against each clerk or agent, and a record thus kept of the work performed upon the cars. These slips are not put upon packages of letters made up for offices direct. During the same six months ending April 30, 1876, the same six months given in the table above, the number of slips returned, which covered packages of letters made up on the fast-mail line, with the number of letters missent, is contained in the following table:

TABLE B.—Fast-mail facing-slip report for six months ending April 30, 1876.

Date.	Number of slips covering packages returned.	Number of slips covering packages correct.	Number of slips covering packages incorrect.	Number of letters sent wrong.	Number of packages sent wrong.
November, 1875 .....	57,400	54,409	2,998	8,277	6
December, 1875 .....	51,976	49,609	2,367	5,050	33
January, 1876 .....	58,490	56,179	2,311	3,818	67
February, 1876 .....	75,019	72,447	2,565	4,156	58
March, 1876 .....	83,903	80,474	3,429	5,693	74
April, 1876 .....	78,922	76,559	2,363	4,455	106
Total .....	404,233	389,070	15,163	31,449	498
Total number of slips covering packages returned .....					404,233
Total number of letters contained in packages covered by slips returned .....					94,253,990
Total number of packages which contained any errors .....					15,163
Total number of letters sent wrong .....					31,449
Number of letters correctly distributed to each letter sent wrong .....					800

This table shows that but one letter out of each 800 distributed was missent, which, considering the rapidity with which the clerks performed their work, is certainly remarkable. On lines where the clerks can take more time and work more deliberately the records stand one error to each 1,500 to 2,000 letters distributed.

Some conception of the immense bulk of mail-matter in transit can be formed from the following statement of mails originating at New York destined for dispatch on the three trunk lines, viz, New York Central, Pennsylvania, and Erie Railway lines to the West only, during the period commencing December 1, 1875, and ending February 8, 1876.

This does not include any mail arriving on other roads transferred through the city. The figures represent pounds:

Date.	Total for each month.	Daily average for each.
December 1 to 31.....	2,030,384	65,496
January 1 to 31.....	1,930,937	62,298
February 1 to 8.....	487,779	60,972
Total.....	4,449,100	63,557

The following is a statement of the total weight of mails for December, 1875, departing from and arriving at New York over the same roads, (New York Central and Hudson River, Pennsylvania, and Erie,) including both the mails originating at New York and those arriving on other roads and transferred through the city to those roads.

*This is for the month of December only.*

Weight of mail forwarded from New York.....	2,803,173
Daily average.....	90,487
Weight of mails arriving at New York.....	1,234,834
Daily average.....	37,404
Total weight of mails arriving at and departing from New York.....	4,038,007
Daily average.....	127,891

A great difficulty to contend with in the railway mail-service on those lines where there is night service, is the lighting of the cars. On almost every line either the lamps are inadequate to the proper lighting of the cars, or the oil is of an inferior quality. Several of the larger lines have gone to a considerable expense in providing lamps, &c., that would insure against trouble in this, but none have been entirely successful. A small appropriation of \$500 for the purpose of testing fully, different lamps and oil for this purpose, would result in immense benefit to the service, if made with a view to furnishing the lighting fixtures and material for all postal cars. The expense would probably not exceed \$2,000 per annum for this purpose, and would be more than balanced by the saving in time of clerks who are compelled to perform their labor by poor and uncertain light. Another and very important object would be the lessening of risk to postal clerks in case of accident, as during the past two years two postal clerks have been burned to death in wrecks where the oil used in the lamps ignited and spread the fire so that rescue was impossible. In one instance the clerk would have escaped with hardly a bruise, but being so wedged in that he could not extricate himself, the heat of the burning wreck rendering aid impossible.

The project of owning the cars used for railway post-offices has been frequently discussed by officers of this service, and is worthy of careful consideration, as it would be beneficial in many ways. It would cost the Government nothing, as the same arrangement could be made with the different companies that is now made by through freight lines, palace car, or other companies controlling their own cars, by which a reduction in the compensation to railroads for mail transportation could be made sufficient to cover depreciations and replacement.

Herewith is submitted a table showing in detail the changes made in railway post-office service for the last fiscal year.

Finally, it is but due to the employes of the Department in this branch of the service that a recognition be made of their fidelity to duty and

the trust reposed in them. The faithful manner in which they perform their service, and oftentimes under very trying circumstances, is unequalled in any other service, and instances of heroic devotion to duty are by no means rare. They seem to appreciate the fact that upon the careful performance of their duties are dependent interests of a magnitude that cannot be estimated, and that a single error on their part, resulting in the delay or missending of a single letter, no matter how unimportant it may look, may result disastrously to some individual or corporation.

Very respectfully,

THEO. N. VAIL,  
*Gen'l Supt.*

Hon. THOS. J. BRADY,  
*Second Assistant Postmaster-General.*

*Statement of the weights of mails dispatched to Postal Union countries during the year.*

	Letters. Grams.	Newspapers and printed matter. Grams.
To Great Britain and Ireland.....	44,258,757	203,014,405
Germany .....	27,085,027	83,922,270
France, (6 months from January 1, 1876).....	6,438,109	24,617,022
Italy .....	1,896,310	6,025,393
Switzerland .....	1,752,586	7,426,462
Sweden .....	2,437,144	3,519,007
Norway .....	1,866,000	2,890,530
Netherlands.....	1,263,326	3,245,532
Denmark .....	1,210,744	2,254,311
Belgium .....	823,714	2,541,378
Spain, (6 months from January 1, 1876).....	257,180	1,239,577
	<hr/>	<hr/>
Estimating for 6 months' weight of mails to France and Spain .....	89,288,897	340,695,867
	<hr/>	<hr/>
Total.....	95,984,186	366,552,486

ARRANGEMENT CONCERNING THE ENTRANCE INTO THE GENERAL POSTAL UNION OF BRITISH INDIA AND THE FRENCH COLONIES.

The postal administration of British India having communicated, in conformity with Article XVII of the treaty concerning the formation of a General Postal Union, concluded at Berne, October 9, 1874, its intention to enter the General Postal Union, and the French Government having made a similar declaration in the name of its colonies,

The undersigned delegates have established, subject to approval, the following provisions:

ARTICLE I.

British India and the French colonies accede to the stipulations of the treaty concerning the formation of a General Postal Union, concluded at Berne the 9th October, 1874, and also to the provisions of the regulations of detail and order established for the execution of said treaty.

ARTICLE II.

The correspondence originating in one of the countries mentioned in Article I, addressed to another country of the Union, and vice-versa, shall be subject to the Union postages adopted by each of the administrations, by virtue of paragraphs 1, 2, 3, 4, and 5 of Article III, and of paragraphs 1, 2 and 3 of Article IV of the treaty of Berne of October 9, 1874.

Each administration shall have the power to add to these postages, as maritime rate, an additional postage which shall not exceed the maximum fixed by Article III, second paragraph, and Article IV, second paragraph, of the Berne treaty, for the prepaid dispatches.

When, however, the conversion of the postages into the national money shall produce fractions, these fractions may be forced to a whole.

It is expressly understood that the additional maritime postage shall be levied but once, even when several maritime services participate in the transportation.



## ARTICLE III.

Under the head of maritime transportation of the correspondence mentioned in Article II, preceding, the despatching administration shall pay to the administration or to the administrations providing this transportation, a bonification :

1st, of 25 francs per kilogramme, net weight, of letters and post-cards; and

2d, of 1 franc per kilogramme, net weight, of matter described in article 4 of the treaty concluded at Berne, October 9, 1874.

When the maritime transportation shall be performed by two or more administrations, the bonification shall be divided among them upon the bases of the distances traversed, without prejudice to the various arrangements which may intervene between the administrations concerned.

No bonifications, however, shall be due for the maritime transportations not exceeding 300 nautical miles.

## ARTICLE IV.

The correspondence, which, by virtue of the final paragraph of Article X of the treaty of Berne, of October 9, 1874, shall have extraordinary transportation expenses to support, may be subjected to an additional charge in proportion to such expenses.

## ARTICLE V.

In regard to the stipulations of Article XXVII of the regulations annexed to the treaty of Berne, concerning the division of the expenses of the International Bureau of the General Postal Union, it is agreed that India shall belong to the 1st class, and the whole of the French colonies to the 3d class, as provided by that article.

## ARTICLE VI.

The present arrangement shall take effect from July 1, 1876.

Done and signed at Berne, in 14 copies, January 27, 1876.

For the German Postal Administration .....	GÜNTHER.
For the Austrian Postal Administration .....	DEWÉZ.
For the Hungarian Postal Administration .....	HEIM.
For the Belgian Postal Administration .....	{ FASSIAUX.
	{ GIFE.
For the Egyptian Postal Administration .....	EUGÈNE BOREL.
For the Spanish Postal Administration .....	{ J. DE HOYOS.
	{ VTE-DE MANZANERA.
For the French Postal Administration .....	ANSAULT.
For the Ministry of Marine and Colonies of	
France, in the name of the French Colonies..	E. ROY.
For the Postal Administration of Great Britain.	ALAN MACLEAN.
For the Postal Administration of British India..	ALAN MACLEAN.
For the Italian Postal Administration .....	TANTESIO.
For the Netherland Postal Administration .....	HOFSTEDE.
For the Postal Administrations of Sweden and	
Norway .....	M. BJOENSTJEENA.

COUNTRIES BEYOND SEA TO WHICH THE ARRANGEMENT CONCLUDED  
AT BERNE 27 JANUARY, 1876, IS APPLICABLE.

# I. BRITISH INDIA.

Hindustan, British Burmah, Aden.

## II. FRENCH COLONIES.

*America*—Martinique, Guadeloupe, and dependencies, French Guiana, St. Pierre, and Miquelon.

*Africa*—Senegal and dependencies, Gaboon, Réunion, Mayotte and dependencies, Ste. Marie de Madagascar.

*Asia*—French establishments in India (Pondicherry, Chandernagor, Karikal, Mahé, and Yanaon) and in Cochin China.

*Oceanica*—New Caledonia and dependencies, Marquesas Islands, Tahiti, and the Archipelagoes subject to the protectorate of France.

DEPARTMENT OF STATE,  
*Washington, August 12, 1876.*

SIR: I have the honor to inclose herewith a copy of a letter dated July 12, received from the President of the Swiss Confederation, through the minister of the United States at Berne, announcing the adhesion of the French colonies and the British Indies to the General Postal Union treaty.

I will thank you to notify me of anything you may desire to have done concerning this subject.

I have the honor to be, sir, your obedient servant,

HAMILTON FISH.

Hon. JAMES N. TYNER,  
*Postmaster-General.*

[Inclosure.]

*Letter of President of Swiss Confederation July 12, 1876.*

BERNE, July 12, 1876.

British India and the French colonies having asked to be admitted into the general postal union, a conference between their administrations and the other administrations interested assembled at Berne in the month of January last, and adopted on the 27th of said month an arrangement which fixes the conditions of the adhesion of those two countries to the stipulations of the treaty of Berne of 9th October, 1874. This arrangement, communicated to all the members of the union by circular of 29th January, encountered no objection within the period of six weeks prescribed by Article XVII of the postal-union treaty, so that, by virtue of this same article, the adhesion of British India and the French colonies, being considered as accomplished, was to be attested by a diplomatic act between the government of the managing administration and the governments of the two administrations admitted into the union.

Consequently, the federal council, in the name of the members of the union, exchanged on the 8th of April with the government of the French Republic, and on the 1st of July with the government of the United Kingdom of Great Britain and Ireland and the government of British

India, acts attesting the definitive adhesion of British India and the French colonies to the stipulations of the treaty of Berne of 9th October, 1874. The federal council has the honor to transmit with the present note to his excellency the Minister of Foreign Affairs of the United States the text of these acts, the duplicates of which, intended for the federal council, in its character of representative of the members of the union, are deposited in the archives of the Swiss Confederation.

The federal council avails itself of this occasion, &c.

In the name of the Swiss federal council.

WELTI,

*The Chancellor of the Confederation Schiess.*

An arrangement concerning the entrance of the French colonies into the general postal union having been concluded at Berne on the 27th January, 1876, between the delegates of the French government and the delegates of the administrations interested forming a part of the postal union, and no objection against this arrangement in consequence of the communication thereof made to all the members of the union by circular of 29th January, 1876, having been presented within the period of six weeks prescribed by Article XVII, paragraph 6, of the treaty of Berne of 9th October, 1874:

The undersigned, duly authorized for that purpose, do attest, by the present diplomatic act, the definitive adhesion of the French government, for its colonies, to the stipulations of the treaty concerning the creation of a general postal union concluded at Berne the 9th of October, 1874, as well as to the provisions of the detailed regulations for the execution of the said treaty.

Done at Berne the 8th of April, 1876.

For the Swiss federal council, in the name of the members of the union:

The president of the confederation,

[L. S.]

WELTI.

For the government of the French Republic:

The ambassador of France to the Swiss Confederation,

[L. S.]

B. D'HARCOURT.

An arrangement concerning the entrance of British India into the general Postal Union having been concluded at Berne on the 27th January, 1876, between the delegates of the British government and the delegates of the administrations interested forming part of the Postal Union, and no objection against this arrangement, in consequence of the communication thereof made to all the members of the union by circular of 29th January, 1876, having been presented within the period of six weeks prescribed by Article XVII, paragraph 6, of the treaty of Berne of 9th October, 1874:

The undersigned, duly authorized for that purpose, do attest by the present diplomatic act, the definitive adhesion of the British government for British India to the stipulations of the treaty concerning the creation of a general Postal Union concluded at Berne the 9th of October, 1874, as well as to the provisions of the detailed regulations for the execution of said treaty.

Done at Berne the 1st of July, 1876.

For the Swiss Federal Council, in the name of the members of the union:

The President of the confederation,

[L. S.]

WELTI.

For the government of the United Kingdom of Great Britain and Ireland, and for the government of British India :

Her British Majesty's minister resident in the Swiss Confederation,  
[L. s.] EDWIN CORBETT.

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POSTAL CONVENTION BETWEEN THE UNITED STATES OF AMERICA AND  
THE COLONIAL GOVERNMENT OF QUEENSLAND.

The undersigned, being thereunto duly authorized by their respective Governments, have agreed upon the following articles, establishing and regulating the exchange of correspondence between the United States of America and the colony of Queensland :

ARTICLE I.

There shall be an exchange of correspondence between the United States of America and Queensland by means of the direct line of colonial mail-packets plying between San Francisco and New South Wales, as well as by such other means of direct mail-steamship transportation between the United States and New South Wales as shall hereafter be established with the approval of the respective post departments of the countries concerned, comprising letters, newspapers, printed matter of every kind, and patterns and samples of merchandise, originating in either country and addressed to and deliverable in the other country, as well as correspondence in closed mails originating in Queensland and destined for foreign countries by way of the United States.

ARTICLE II.

The post-office of San Francisco shall be the United States office of exchange, and Brisbane the office of exchange of the colony of Queensland for all mails transmitted under this arrangement.

ARTICLE III.

No accounts shall be kept between the post-departments of the two countries upon the international correspondence, written or printed, exchanged between them, but each country shall retain to its own use the postages which it collects.

The single rate of international letter-postage shall be twelve cents in the United States and sixpence in Queensland on each letter weighing half an ounce or less, and an additional rate of twelve cents (sixpence) for each single weight of half an ounce or fraction thereof, which shall in all cases be prepaid at least one single rate by means of postage-stamps at the office of dispatch in either country. Letters unpaid, or prepaid less than one full rate of postage, shall not be forwarded, but insufficiently-paid letters, on which a single rate or more has been prepaid, shall be forwarded, charged with the deficient postage, to be collected and retained by the post-department of the country of destination.

The United States post-office shall levy and collect to its own use on newspapers addressed to Queensland a postage charge of two cents, and on all other articles of printed matter, patterns and samples of merchandise, addressed to Queensland, a postage charge of four cents per each weight of four ounces or fraction of four ounces.

The post-office of Queensland shall levy and collect to its own use on

newspapers addressed to the United States a postage charge of two cents, and on other articles of printed matter, patterns and samples of merchandise, addressed to the United States, a postage charge of four cents per each weight of two ounces or fraction of two ounces.

Letters, newspapers, and other articles of printed matter, patterns and samples of merchandise, fully prepaid, which may be received in either country from the other, shall be delivered free of all charge whatsoever.

Newspapers and all other kinds of printed matter, and patterns and samples of merchandise, are to be subject to the laws and regulations of each country, respectively, in regard to their liability to be rated with letter postage when containing written matter, or for any other cause specified in said laws and regulations, as well as in regard to their liability to customs duty under revenue laws.

#### ARTICLE IV.

The United States office engages to grant the transit through the United States, as well as the conveyance by the United States mail-packets, of the correspondence in closed mails which the Queensland post-office may desire to transmit via the United States to British Columbia, the British North American provinces, the West Indies, Mexico, Central and South America, and at the following rates of United States transit-postage, viz :

For the United States territorial transit of closed mails from Queensland for Mexico, British Columbia, Canada, or other British North American provinces, when transmitted entirely by land-routes, six cents per ounce for letter-mails, and sixteen cents per pound for all kinds of printed matter.

For the United States territorial and sea transit of closed mails from Queensland for British Columbia or other British North American provinces, Mexico, Central and South America, or the West India Islands, when transmitted from the United States by sea, twenty-five cents per ounce for letter-mails, and twenty cents per pound for all kinds of printed matter.

The Queensland post office shall render an account to the United States post office, upon letter-bills to accompany each mail, of the weight of the letters, and also of the printed and other matter contained in such closed mails, forwarded to the United States for transmission to either of the above-named countries and colonies, and the accounts arising between the two offices on this class of correspondence shall be stated, adjusted, and settled quarterly, and the amounts of the United States transit-charges found due on such closed mails shall be promptly paid over by the Queensland post office to the United States post office in such manner as the Postmaster-General of the United States shall prescribe.

#### ARTICLE V.

Prepaid letters from foreign countries received in and forwarded from the United States to Queensland shall be delivered in said colony free of all charges whatsoever, and letters received in Queensland from the United States addressed to other colonies of Australia will be forwarded to destination subject to the same conditions as are applicable to correspondence originating in Queensland and addressed to those countries.

## ARTICLE VI.

The two post-departments may, by mutual agreement, provide for the transmission of registered articles in the mails exchanged between the two countries.

The register-fee for each article shall be ten cents in the United States and fourpence in Queensland.

## ARTICLE VII.

The two post-departments shall settle by agreement between them all measures of detail and arrangement required to carry this convention into execution, and may modify the same in like manner, from time to time, as the exigencies of the service may require.

## ARTICLE VIII.

Every fully prepaid letter dispatched from one country to the other shall be plainly stamped with the words "paid all," in *red ink*, on the right-hand upper corner of the address, in addition to the date-stamp of the office at which it was posted, and on insufficiently-paid letters the amount of the deficient postage shall be inscribed in *black ink*.

## ARTICLE IX.

Dead letters, which cannot be delivered from whatsoever cause, shall be mutually returned, without charge, monthly, or as frequently as the regulations of the respective offices will permit.

## ARTICLE X.

This convention shall come into operation on the 1st day of January, 1876, and shall be terminable at any time on a notice, by either office, of six months.

Done in duplicate and signed in Brisbane, the eighth day of December, in the year of our Lord one thousand eight hundred and seventy-five, and in Washington on the second day of February, one thousand eight hundred and seventy-six.

[SEAL.]

MARSHALL JEWELL,  
*Postmaster-General of the United States.*  
GEORGE THORN, JUNIOR,  
*Postmaster-General of Queensland.*

Approved.

EWD. CAIRNS.

I hereby approve the foregoing convention, and in testimony thereof I have caused the seal of the United States to be affixed.

[SEAL.]

U. S. GRANT.

By the President:

HAMILTON FISH,  
*Secretary of State.*

WASHINGTON, *February 5, 1876.*

ADDITIONAL AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE EMPIRE OF JAPAN, MODIFYING THE PROVISIONS OF THE POSTAL CONVENTION OF THE 6TH AUGUST 1873, AND ALSO OF THE AGREEMENT OF APRIL 26TH 1875 BETWEEN THE TWO COUNTRIES.

The undersigned being thereunto duly authorized by their respective Governments have agreed to modify the provisions of the Postal Convention between the United States and Japan, concluded the 6th day of August, A. D. 1873, or the 6th day of the 8th month of the 6th year of Meiji, and of the Agreement between the United States and Japan, signed at Washington the 26th day of April A. D. 1875, as follows :

1st. It is agreed that the second paragraph of Article III of the said Convention be so modified that the single rate of international letter postage shall be reduced to five cents in the United States and five sen in Japan, on each letter weighing fifteen grammes (one half ounce) or less, and an additional rate of five cents or five sen for each additional weight of fifteen grammes, (one half ounce) or fraction thereof.

Also that the Agreement between the United States and Japan, signed at Washington the 26th day of April A. D. 1875, relative to the international postage on newspapers and other printed matter, patterns and samples of merchandize exchanged between the two countries be so modified that the postage to be levied, collected, and retained by the Post Office of the country of origin shall be reduced to two cents in the United States and two sen in Japan on each newspaper not exceeding four ounces in weight, and two cents or sen for each weight of two ounces or fraction of two ounces on all other articles of printed matter, patterns and samples of merchandize.

2nd. It is further agreed, in view of the fact that the Japanese Government is about to establish a Postal Agency at Shanghai, China ; that the same rates of postage and conditions of exchange shall be applied to correspondence of every kind originating in said Japanese Postal Agency, and despatched through the exchange office of Yokohama to the United States or to foreign countries via the United States, as are applied to the correspondence similarly addressed, originating in the Empire of Japan.

3rd It is further agreed that the respective Japanese post offices of Yokohama, Hiogo, and Nagasaki may exchange correspondence by means of American or Japanese mail packets with the Japanese Postal Agency at Shanghai.

And it is also agreed, that the single rate of letter postage to be levied and collected at the United States Postal Agency at Shanghai on letters addressed to Japan, shall be five instead of six cents as stipulated in Article V of the Postal Convention between the two countries—and in like manner, a reduced single letter rate of five sen shall be levied and collected in Japan on letters for Shanghai when despatched in the mails to the United States Postal Agency at that port.

4th It is also hereby agreed that the provisions of Article V of the Postal Convention of August 6th 1873, as herein modified, shall continue in force until the 31st of December, 1876, the date of expiration of the existing contract between the United States and the Pacific Mail Steamship Company, for the mail service between Yokohama and Shanghai, touching at the ports of Hiogo and Nagasaki ; and that on and after January 1, 1877, its provisions shall apply only to such mails, if any, as shall after that date be exchanged between the Japanese post office at Yokohama, and the United States Postal Agency at Shanghai, by means

of mail packets under contract with the United States Post Office, Department performing regular trips between the port of Yokohama, Japan, and the port of Shanghai, China.

This agreement shall be carried into operation on the 1st day of April A. D. 1876, or on the 1st day of the 4th month of the 9th year of Meiji.

Done in duplicate original and signed at Washington this eighth day of February one thousand eight hundred and seventy six, or the 8th day of the 2nd month of the 9th year of Meiji.

[L. S.]

MARSHALL JEWELL

*Postmaster General of the United States.*

YOSHIDA KIYONARI

*His Imperial Japanese Majesty's Envoy Extraordinary and  
Minister Plenipotentiary to the United States of America.*

I hereby approve the foregoing Agreement, and in testimony thereof, I have caused the seal of the United States to be hereto affixed.

[L. S.]

U. S. GRANT.

By the President

HAMILTON FISH,

*Secretary of State.*

WASHINGTON, February 8th 1876.

#### *Translation.*

I hereby approve the foregoing Agreement and in testimony thereof I have caused the seal of the Empire of Japan to be affixed.

[L. S.]

MUTSUHITO.

The 31st day of the 3rd month of the 9th year, Meiji.

By order of His Majesty

TERASHIMA MUNENORI.

*Minister for Foreign Affairs.*

#### POSTAL CONVENTION BETWEEN THE UNITED STATES OF AMERICA AND BERMUDA.

The undersigned, being thereunto duly authorized by their respective governments, have agreed upon the following articles, establishing and regulating the exchange of correspondence between the United States of America and Bermuda:

##### ARTICLE I.

There shall be an exchange of mails between the United States of America and Bermuda, by such means of transportation as are now, or shall hereafter be, established with the approval of the respective Post Departments of the two countries, comprising letters, and manuscript subject by the laws of either country to letter rate of postage, newspapers, books, printed matter of every kind, sheets of music, engravings, lithographs, photographs, drawings, maps, and plans originating in either country and addressed to and deliverable in the other country.

Each office shall make its own arrangements for, and at its own cost pay the expense of, the intermediate sea-transportation of the mails which it despatches to the other.



## ARTICLE II.

New York shall be the office of exchange on the side of the United States, and Hamilton shall be the office of exchange on the side of Bermuda, for all mails transmitted between the two countries under this arrangement; and all mail matter transmitted in either direction between the respective offices of exchange shall be forwarded in closed bags or pouches, under seal, addressed to the corresponding exchange office.

The two Post Departments may at any time discontinue either of said offices of exchange or establish others.

## ARTICLE III.

The standard weight for the single rate of postage and rule of progression shall be:

1. For letters or manuscripts subject by law to letter rate of postage, fifteen grammes, (one half ounce avoirdupois.)

2. For all other correspondence mentioned in the first article, that which each country shall adopt for the mails which it despatches to the other, adapted to the convenience and habits of its interior administration. But each country shall give notice to the other of the standard weight it adopts, and of any subsequent change thereof. The weight stated by the despatching exchange office shall always be accepted, except in cases of manifest error.

## ARTICLE IV.

No accounts shall be kept between the Post Office Departments of the two countries, on the international correspondence, written or printed, exchanged between them; but each country shall levy, collect, and retain to its own use, the following postal charges, viz:

1. The rate of postage to be charged and collected in the United States on each prepaid letter or manuscript subject to letter postage, addressed to Bermuda, shall be five (5) cents United States currency, for each weight of fifteen grammes or fraction thereof; and the rate of postage to be charged and collected in Bermuda on each prepaid letter or manuscript subject to letter postage, addressed to the United States of America, shall be two pence, the same to be in each case in full of all charges whatever, to the place of destination in either country.

The charge on unpaid letters shall be double the rate levied in the country of destination on prepaid letters.

2. On all other articles of correspondence mentioned in the first article, the Post Departments of the United States and Bermuda may respectively levy, collect, and retain to their separate and exclusive use, such rates of postage adapted to their interior administration and to the cost of sea transportation, as they shall deem advisable; which rates shall, in like manner, be in full of all charges whatever, to the place of destination in either country. But each office shall give notice to the other of the rates it adopts for such correspondence, and of any subsequent change thereof. The maximum weight of such correspondence is fixed at 4 pounds.

Newspapers and other correspondence of the class referred to in the preceding paragraph, shall be sent in narrow bands, or covers open at the sides or ends, so that they may be easily examined; and packages of such correspondence shall be subject to the laws and regulations of each country in regard to their liability to pay customs duty, if contain-

ing dutiable goods; or to be rated with letter postage when containing written matter, or for any other cause specified in said laws and regulations.

#### ARTICLE V.

Prepayment of postage of every description of article can be effected only by means of postage stamps or stamped envelopes valid in the country of origin.

The correspondence to be reciprocally exchanged, shall be impressed on the upper part of the address with a stamp indicating the place of origin and date of posting.

Unpaid or insufficiently paid letters, or manuscripts subject by law to letter rate of postage, shall, in addition, be impressed with the stamp T (tax to be paid), the application of which shall devolve upon the exchange office of the country of origin.

Every international letter, or manuscript subject to letter postage, which does not bear the stamp T, shall be considered as fully paid to destination, and treated accordingly, unless there be an obvious error.

When a letter, or any manuscript subject by law to letter postage, unpaid or insufficiently paid, shall be liable, by reason of its weight, to more than a single rate of postage, the despatching office shall indicate in the upper right-hand corner of the address, in ordinary figures, the number of rates to which it is liable.

When a letter shall be insufficiently prepaid by means of postage stamps, the despatching office shall indicate, in figures in black ink, placed by the side of the postage stamps, their total value expressed in the currency of the country of destination.

In case postage stamps may be used which are not of any value in the country of origin, no account shall be taken of them. This fact shall be indicated by the figure "0," placed by the side of the postage stamps.

The office of the country of destination shall charge the insufficiently paid letters with the amount of the deficient postage calculated at the rate of an unpaid letter of the same weight.

In case of need, fractions may be raised to the necessary unit of charge in force in the country of destination.

#### ARTICLE VI.

Letters, and other communications in manuscript, which, from any cause, cannot be delivered to their address, after the expiration of a proper period to effect their delivery shall be reciprocally returned every month, unopened and without charge, to the Post Office Department of the despatching country; but newspapers and all other articles of printed matter shall not be returned, but remain at the disposal of the receiving office.

Letters erroneously transmitted or wrongly addressed, shall be promptly returned to the despatching office without charge.

#### ARTICLE VII.

To accommodate the Bermuda Government, and at the same time maintain the condition that postage accounts shall not be kept between the two countries, the Post Office Department of the United States will forward, without charge, to the Canada frontier and *vice-versa*, such correspondence, in sealed bags of small weight and bulk, as the Bermuda Post Office may exchange directly with the Dominion of Canada, through the United States; but should the weight and bulk of such mails at any

time be deemed too great to justify this concession, the Post Office Department of the United States reserves the right to withdraw it, upon giving notice to that effect.

#### ARTICLE VIII.

Letters originating in foreign countries and addressed to the United States or to Bermuda respectively, on which the foreign and international postage charges are fully prepaid, shall, when forwarded in the mails of either country to the other, be delivered in the country of destination free of charge.

Official correspondence between the two Post Departments relating exclusively to the postal service, shall be exempt from postage charges.

#### ARTICLE IX.

Neither Post Department shall be required to deliver any article received in the mails, the circulation of which shall be prohibited by the laws in force in the country of destination. And any article subject, by the laws of either country, to customs duty or to confiscation, shall, when received in the mails from the other, be treated in accordance with the laws of the receiving country.

#### ARTICLE X.

The two Post Departments may provide for the transmission of registered articles in the mails exchanged between the two countries.

The registration fee for each article shall be ten cents in the United States and six pence in Bermuda.

#### ARTICLE XI.

The two Post Departments shall settle, by agreement between them, all measures of detail and arrangement required to carry this Convention into execution, and may modify the same, in like manner, from time to time, as the exigencies of the service may require.

#### ARTICLE XII.

This Convention shall come into operation on the first day of October, and shall be terminable at any time on a notice, by either office, of six months.

Done in duplicate and signed in Washington on the twenty-ninth day of August, 1876, and in Hamilton on the ninth day of August, 1876.

[SEAL.]

JAS. N. TYNER,

*Postmaster-General of the United States.*

J. H. LEFROY,

*Major-General,*

*Governor and Commander-in-Chief of the Bermudas.*

I hereby approve the foregoing Convention, and in testimony thereof I have caused the seal of the United States to be affixed.

[SEAL.]

U. S. GRANT.

By the President:

W. HUNTER,

*Acting Secretary of State.*

WASHINGTON, Sept. 4th, 1876.

ADDITIONAL ARTICLE OF AGREEMENT BETWEEN THE POST-OFFICE DEPARTMENTS OF THE UNITED STATES OF AMERICA AND NEW-FOUNDLAND.

SOLE ARTICLE.

It is agreed that the single rate of international letter-postage, in full to destination, shall be five cents on each letter weighing half an ounce (15 grammes) or less, and an additional rate of five cents for each additional weight of half an ounce (15 grammes) or fraction thereof, the prepayment of which shall be compulsory at the office of mailing in either country.

This article shall take effect immediately, superseding the provisions of the second paragraph of article 3 of the Postal Convention of 20-30 November, 1872, which paragraph is hereby rescinded.

In witness whereof the Postmaster General of the United States of America and the Postmaster General of Newfoundland have hereto set their hands and affixed their seals at the date set opposite to each respectively.

[L. S.]

JAS. N. TYNER,

*Postmaster General of the United States of America.*

October 6, 1876.

JOHN DELANEY,

*Postmaster General Newfoundland.*

September 22, 1876.

I hereby approve the foregoing additional article, and in testimony thereof I have caused the seal of the United States to be affixed.

[L. S.]

U. S. GRANT.

By the President:

JOHN L. CADWALADER,

*Acting Secretary of State, Washington.*

SPECIAL ARRANGEMENT BETWEEN THE GENERAL POST-OFFICES OF THE UNITED STATES AND THE UNITED KINGDOM, FIXING RATES OF TERRITORIAL TRANSIT-CHARGES ON BRITISH CLOSED MAILS CONVEYED ACROSS THE AMERICAN CONTINENT BETWEEN BOSTON OR NEW YORK AND SAN FRANCISCO.

Whereas Article X of the treaty concerning the formation of a general postal union, signed at Berne October 9, 1874, provides that the territorial transit-charges on the mails conveyed across the United States of America by the railways between New York and San Francisco shall continue to form the object of special arrangements between the post-offices concerned; and whereas the territorial transit-rates for the conveyance of correspondence in closed mails through the United States, fixed by the eleventh article of the postal convention of November 7-24, 1868, between the General Post-Office of the United States of America and the general post-office of the United Kingdom of Great Britain and Ireland, were, by a notice of one year, terminated on the 24th of August, 1876: The undersigned, being thereunto duly authorized by their respective governments and acting for and in behalf of the General Post-Offices of the United States and of the United Kingdom, respectively, do hereby agree that the territorial transit-charges to be paid by the British post-office to the United States Post-Office on the British

closed mails conveyed on and after the 24th of August, 1876, across the territory of the United States, between Boston or New York and San Francisco, shall be 6 francs per kilogramme of letters and 2 francs per kilogramme of newspapers, other printed matter, and patterns and samples of merchandise.

This agreement shall be terminable at any time on a notice by either office of one year.

In testimony whereof the undersigned have subscribed their names and affixed their seals hereto, at Washington, in duplicate original, this 6th day of October, 1876.

[SEAL.]

JAS. N. TYNER,

*Postmaster-General of the United States.*

EDW'D THORNTON,

*Her Britannic Majesty's Minister.*

Table showing the increase and decrease of post-offices in the several States and Territories; also the number of post-offices at which appointments are made by the President and by the Postmaster-General for the year ended June 30, 1876.

States and Territories.	Whole number of post-offices in the United States June 30, 1875.	Whole number of post-offices in the United States June 30, 1876.	Increase.	Decrease.	Number of postmasters ap- pointed by the President June 30, 1875.	Number of postmasters ap- pointed by the President June 30, 1876.	Increase.	Decrease.	Number of postmasters ap- pointed by the Postmaster- General June 30, 1875.	Number of postmasters ap- pointed by the Postmaster- General June 30, 1876.	Increase.	Decrease.
Alabama.....	785	796	11	....	17	17	....	....	768	779	11	....
Alaska.....	2	2	....	....	....	....	....	....	2	2	....	....
Arizona.....	49	39	....	3	3	3	....	....	39	36	....	3
Arkansas.....	663	636	....	27	9	9	....	....	654	637	....	17
California.....	731	763	32	....	32	35	3	....	699	726	27	....
Colorado.....	188	219	31	....	9	12	3	....	179	200	21	....
Connecticut.....	435	444	9	....	44	45	1	....	391	399	8	....
Dakota.....	133	148	15	....	2	2	....	....	131	146	15	....
Delaware.....	101	102	1	....	6	6	....	....	95	96	1	....
District of Columbia.....	6	6	....	....	2	2	....	....	4	4	....	....
Florida.....	206	222	16	....	6	6	....	....	200	216	16	....
Georgia.....	715	754	39	....	23	23	....	....	692	731	39	....
Idaho.....	68	74	6	....	2	3	1	....	66	71	5	....
Illinois.....	1,065	1,087	22	....	136	136	2	....	1,729	1,749	20	....
Indiana.....	1,494	1,523	29	....	67	68	1	....	1,457	1,455	28	....
Indian Territory.....	....	55	55	....	....	....	....	....	55	55	....	....
Iowa.....	1,352	1,370	18	....	80	84	4	....	1,272	1,296	24	....
Kansas.....	1,064	1,104	40	....	38	38	....	....	1,026	1,066	40	....
Kentucky.....	1,062	1,110	48	....	28	28	....	....	1,034	1,069	48	....
Louisiana.....	338	345	7	....	6	6	....	....	332	339	7	....
Maine.....	869	877	8	....	28	28	....	....	841	848	6	....
Maryland.....	606	619	13	....	14	14	....	....	592	605	13	....
Massachusetts.....	715	721	6	....	100	102	2	....	615	619	4	....
Michigan.....	1,902	1,925	23	....	70	70	....	....	1,132	1,155	23	....
Minnesota.....	814	832	18	....	23	23	....	....	791	809	18	....
Mississippi.....	560	576	16	....	21	21	....	....	539	555	16	....
Missouri.....	1,525	1,510	....	15	46	46	....	....	1,479	1,464	....	15
Montana.....	100	94	....	6	4	4	....	....	96	94	....	6
Nebraska.....	559	584	25	....	14	15	1	....	545	569	24	....
Nevada.....	88	92	4	....	9	9	....	....	79	83	4	....
New Hampshire.....	434	436	2	....	23	23	....	....	411	413	2	....
New Jersey.....	654	655	1	....	46	47	1	....	608	608	....	....
New Mexico.....	66	72	6	....	3	3	....	....	63	69	6	....
New York.....	2,815	2,835	20	....	179	182	3	....	2,636	2,653	17	....
North Carolina.....	1,045	1,134	89	....	13	13	....	....	1,032	1,121	89	....
Ohio.....	2,164	2,189	25	....	113	113	....	....	2,051	2,076	25	....
Oregon.....	268	291	23	....	6	6	....	....	269	285	23	....
Pennsylvania.....	3,113	3,155	42	....	132	131	1	....	2,961	3,024	43	....
Rhode Island.....	104	104	....	....	11	11	....	....	93	93	....	....
South Carolina.....	460	496	36	....	13	13	....	....	447	483	36	....
Tennessee.....	1,046	1,076	30	....	19	19	....	....	1,027	1,057	30	....
Texas.....	861	908	47	....	30	30	....	....	831	878	47	....
Utah.....	171	171	....	....	3	3	....	....	168	168	....	....
Vermont.....	484	482	....	....	21	21	....	....	463	467	....	....
Virginia.....	1,404	1,441	37	....	24	24	....	....	1,360	1,417	37	....
Washington.....	155	143	....	7	3	3	....	....	152	145	....	7
West Virginia.....	746	774	28	....	10	10	....	....	736	764	28	....
Wisconsin.....	1,229	1,244	15	....	56	56	....	....	1,173	1,188	15	....
Wyoming.....	40	44	4	....	3	3	....	....	37	41	4	....
Total.....	35,547	36,383	894	58	1,547	1,568	22	1	34,000	34,815	873	58

*Total operations of the appointment-office for the year ended June 30, 1876.*

States and Territories.	Post-offices.				Postmasters.			Total number of cases.
	Established.	Discontinued.	Names and sites changed.	Appointments on change of name and sites.	Resigned and commissions expired.	Removed.	Deceased.	
Alabama.....	65	54	9	7	151	45	8	332
Alaska.....								
Arizona.....	6	9	3	3	7		1	26
Arkansas.....	83	59	12	2	125	33	7	319
California.....	68	36	20	12	132	14	7	277
Colorado.....	37	13	8	7	62	5	2	127
Connecticut.....	11	2	9	1	36	3	4	65
Dakota.....	24	9	1		38	8	3	83
Delaware.....	2	1	3	3	10		1	17
District of Columbia.....								
Florida.....	31	15	5	2	48	13	3	115
Georgia.....	71	32	7	5	123	18	6	257
Idaho.....	10	4			11	1		26
Illinois.....	80	58	25	24	315	33	19	536
Indiana.....	63	34	10	7	314	35	20	476
Indian Territory.....	10	6	2	1	8	4	1	31
Iowa.....	63	45	17	8	217	49	7	396
Kansas.....	78	38	37	23	250	35	11	449
Kentucky.....	83	35	9	5	159	45	8	339
Louisiana.....	31	24	6	4	62	25	2	150
Maine.....	13	5	4	2	55	5	11	93
Maryland.....	27	14	11	7	82	5	4	143
Massachusetts.....	7	1	7		23	7	1	46
Michigan.....	50	27	14	7	158	28	8	265
Minnesota.....	47	29	10	7	132	29	1	248
Mississippi.....	40	24	5	4	105	24	6	204
Missouri.....	77	92	19	5	249	81	17	535
Montana.....	6	12	3		15	9		45
Nebraska.....	57	32	14	12	98	27	2	236
Nevada.....	5	1	1	1	8	6	1	22
New Hampshire.....	5	3			35	7	4	54
New Jersey.....	8	7	6		37	15	6	79
New Mexico.....	10	4	1		16	7	3	41
New York.....	40	20	15	6	221	70	30	396
North Carolina.....	138	49	15	12	142	48	12	404
Ohio.....	39	14	14	9	278	81	21	447
Oregon.....	38	15	8	6	68	4	2	135
Pennsylvania.....	80	38	36	12	289	83	36	572
Rhode Island.....	1	1	1		7	2	1	13
South Carolina.....	56	20	5	1	84	6		171
Tennessee.....	98	68	9	5	156	23	12	366
Texas.....	95	48	10	5	239	31	16	439
Utah.....	6	6	1	1	19	7	3	42
Vermont.....	5	1	7	6	33	14	2	62
Virginia.....	100	63	20	3	180	26	11	400
Washington.....	9	16	5	4	39	1		70
West Virginia.....	72	44	6	2	99	12	6	239
Wisconsin.....	42	27	14	13	176	20	6	285
Wyoming.....	6	2	2	1	19	1	1	31
Total.....	1,993	1,157	446	251	5,140	1,045	333	10,114

## Statement of the operations of the free-delivery

Post-offices.	Number of carriers in service June 30, 1876.	Delivered.					
		Mail.		Local.		Registered letters.	Newspapers.
		Letters.	Postal cards.	Letters.	Postal cards.		
Albany, N. Y.	25	2,471,979	244,567	279,990	173,603	3,962	1,092,640
Allegheny, Pa.	11	960,459	89,611	120,487	39,358	2,795	652,400
Atlanta, Ga.	6	646,415	108,454	32,485	38,767	9,133	248,252
Baltimore, Md.	62	5,484,974	544,693	940,799	553,257	23,261	1,854,897
Bangor, Me.	4	258,727	41,592	16,651	5,858	2,797	144,283
Boston, Mass.	154	10,401,673	1,673,978	4,423,901	1,511,184	73,130	4,644,713
Bloomington, Ill.	6	393,318	95,505	32,449	16,617	2,272	243,340
Brooklyn, N. Y.	89	4,668,435	743,405	1,098,752	592,969	18,792	2,662,167
Buffalo, New York.	34	3,486,200	314,603	369,604	239,189	29,315	1,892,333
Burlington, Iowa.	6	554,861	73,527	36,689	29,627	2,482	445,244
Camden, N. J.	6	448,371	78,465	54,799	32,300	1,085	250,549
Charleston, S. C.	8	430,492	55,601	46,179	27,558	2,699	241,138
Chicago, Ill.	157	16,788,399	2,143,540	2,906,115	1,332,709	137,569	4,631,757
Cincinnati, Ohio.	72	6,475,708	719,581	1,135,652	585,684	23,240	1,715,018
Cleveland, Ohio.	32	3,568,666	666,646	488,697	229,187	34,465	1,680,106
Columbus, Ohio.	12	841,005	150,916	71,662	47,079	3,811	464,702
Covington, Ky.	4	247,943	34,034	14,316	4,216	942	163,170
Davenport, Iowa.	7	468,816	86,277	30,818	19,841	2,002	313,266
Dayton, Ohio.	12	1,045,370	161,922	122,686	65,010	8,755	589,288
Des Moines, Iowa.	6	510,673	104,695	49,307	26,920	3,128	314,643
Detroit, Mich.	31	4,471,074	687,318	480,192	150,433	33,748	2,008,921
Dubuque, Iowa.	5	438,051	87,592	22,409	90,139	2,991	300,780
Easton, Pa.	6	660,856	114,369	43,844	14,117	1,220	303,378
Elizabeth, N. J.	6	469,828	62,899	72,044	16,636	1,065	358,932
Elmira, N. Y.	6	674,920	105,862	44,730	23,137	3,447	289,397
Erie, Pa.	7	596,295	42,735	50,361	32,684	7,711	429,297
Evansville, Ind.	7	535,997	91,696	18,654	23,047	2,717	329,909
Fall River, Mass.	4	327,004	27,814	35,176	12,700	786	294,050
Fort Wayne, Ind.	7	802,366	89,912	96,317	84,070	2,807	622,263
Grand Rapids, Mich.	8	968,799	160,769	109,396	42,817	5,409	575,359
Harrisburgh, Pa.	6	350,068	60,988	26,473	12,989	890	271,361
Hartford, Conn.	11	884,462	157,353	192,719	89,452	2,501	625,406
Hoboken, N. J.	4	235,138	40,804	16,072	21,962	1,213	80,169
Indianapolis, Ind.	28	2,925,542	387,378	281,473	166,320	24,851	1,170,732
Jersey City, N. J.	14	1,262,889	88,903	117,405	66,179	2,651	414,576
Kansas City, Mo.	11	1,333,137	173,305	88,374	55,057	7,560	757,024
La Fayette, Ind.	5	331,319	73,454	28,714	6,810	1,181	231,535
Lancaster, Pa.	5	513,389	67,090	23,894	16,000	1,279	266,364
Lawrence, Mass.	8	656,055	56,810	38,101	45,013	1,887	368,566
Leavenworth, Kans.	5	330,972	62,182	16,361	11,165	1,545	327,692
Louisville, Ky.	30	2,835,060	457,916	300,596	255,063	16,502	1,133,347
Lowell, Mass.	10	664,068	90,434	66,477	39,226	1,649	312,349
Lynn, Mass.	7	522,844	92,090	35,463	45,401	420	259,573
Manchester, N. H.	5	536,385	87,269	30,942	33,518	2,544	482,644
Memphis, Tenn.	13	1,366,221	156,879	101,355	46,097	10,326	400,190
Milwaukee, Wis.	26	3,253,376	242,136	242,636	230,232	17,898	822,609
Minneapolis, Minn.	9	633,754	64,861	68,484	34,557	2,342	531,229
Mobile, Ala.	6	269,371	33,327	32,958	9,781	620	309,280
Nashville, Tenn.	10	1,012,479	152,202	73,026	44,961	9,661	620,206
Newark, N. J.	24	1,831,716	320,407	396,966	181,856	10,006	844,707
New Bedford, Mass.	7	665,178	54,134	35,395	21,511	736	363,950
New Haven, Conn.	17	824,689	105,032	123,350	55,058	1,711	652,799
New Orleans, La.	44	1,559,638	147,575	273,861	180,148	8,948	791,176
New York, N. Y.	429	34,144,032	3,913,615	21,070,850	5,860,871	234,931	8,545,051
Norfolk, Va.	6	551,975	70,426	35,029	25,960	1,047	194,414
Omaha, Nebr.	6	561,396	83,437	44,947	23,349	4,262	329,455
Oswego, N. Y.	6	402,513	62,992	30,912	11,609	1,167	191,142
Patterson, N. J.	7	492,277	43,342	53,080	22,409	1,407	252,700
Peoria, Ill.	8	606,575	113,268	37,541	22,556	2,687	307,997
Petersburgh, Va.	5	367,740	45,577	18,967	9,466	9,117	164,186
Philadelphia, Pa.	247	20,413,437	2,514,511	11,315,781	3,368,066	78,256	10,914,146
Pittsburgh, Pa.	34	2,377,897	214,746	473,887	158,918	8,229	1,143,381
Portland, Me.	10	610,490	109,186	55,403	53,977	1,830	553,363
Pottsville, Pa.	4	268,347	45,731	28,400	9,500	836	261,810
Poughkeepsie, N. Y.	6	585,457	54,435	52,786	47,625	1,117	461,359
Providence, R. I.	20	1,058,067	138,303	296,095	72,543	2,460	535,764
Quincy, Ill.	7	490,041	105,292	32,531	23,554	3,747	429,004
Reading, Pa.	9	670,108	87,671	58,956	36,817	1,485	392,612
Richmond, Va.	16	1,245,563	189,167	91,160	71,557	8,549	499,760
Rochester, N. Y.	23	2,598,938	146,718	193,221	170,262	10,427	1,100,721
Saint Joseph, Mo.	7	678,435	102,794	38,259	23,282	5,003	503,131
Saint Louis, Mo.	107	9,614,250	1,068,578	1,273,709	676,448	66,949	3,742,720

\* Eight carriers at this office until October 1, 1875, and seven until June 1, 1876.



system for the year ended June 30, 1876.

Collected.			Pieces handled.		Cost of service, (including incidental expenses.)			Postage on local matter.
Letters.	Postal cards.	Newspapers.	Aggregate.	Per carrier.	Aggregate.	Per piece.	Per carrier.	
1, 733, 746	225, 272	217, 056	6, 372, 815	254, 913	\$21, 083 63	<i>Mills.</i>	\$843 34	\$8, 715 05.
691, 422	72, 101	63, 666	2, 692, 299	244, 754	8, 885 68	3.30	807 79	3, 256 19
450, 501	124, 161	41, 525	1, 708, 693	284, 789	4, 354 00	2.55	725 67	1, 897 44
6, 477, 733	1, 079, 422	351, 946	17, 310, 989	279, 209	57, 445 96	3.32	926 55	30, 354 55
364, 481	73, 825	31, 374	939, 588	234, 897	3, 447 30	3.66	861 82	1, 023 98
16, 504, 786	2, 957, 651	2, 964, 281	45, 155, 287	293, 216	122, 828 71	2.72	797 59	149, 276 75
222, 684	73, 842	24, 556	1, 104, 563	184, 097	4, 520 95	4.09	753 49	1, 447 27
3, 369, 283	803, 965	374, 459	14, 332, 197	161, 035	81, 133 39	5.66	911 61	45, 373 25
2, 149, 683	423, 460	236, 593	9, 140, 990	268, 852	32, 254 36	3.52	948 66	12, 234 49
476, 353	87, 089	170, 955	1, 876, 827	312, 805	4, 272 84	2.28	719 14	1, 292 23
244, 640	52, 052	39, 446	1, 204, 207	200, 701	4, 529 22	3.78	754 92	1, 768 16
353, 347	56, 359	42, 344	1, 257, 717	157, 215	5, 882 43	4.67	735 30	2, 369 22
18, 776, 744	4, 399, 318	4, 338, 570	55, 584, 721	354, 043	142, 396 67	2.56	906 54	78, 012 57
3, 902, 439	768, 863	334, 585	15, 650, 770	217, 372	65, 799 18	4.20	913 88	47, 838 17
2, 694, 269	700, 362	295, 352	10, 366, 680	323, 959	30, 356 41	2.93	948 64	17, 366 72
623, 322	162, 024	49, 617	2, 414, 158	201, 180	9, 558 97	3.96	796 58	3, 482 84
112, 608	15, 572	8, 392	6, 011, 103	150, 276	2, 761 70	4.59	690 42	675 28
967, 075	66, 468	22, 277	1, 276, 840	182, 406	5, 628 38	4.41	804 05	1, 335 60
905, 849	245, 993	367, 634	3, 512, 447	292, 704	9, 656 46	2.75	804 70	2, 647 12
2, 141, 599	74, 666	42, 758	1, 468, 389	244, 732	4, 959 30	3.37	896 55	1, 932 74
2, 156, 331	440, 832	231, 208	10, 640, 057	343, 228	28, 478 24	2.68	918 65	11, 855 20
441, 530	126, 548	54, 475	1, 502, 495	300, 499	3, 779 40	2.51	755 88	1, 018 85
544, 396	101, 168	315, 287	2, 098, 635	349, 773	4, 754 74	2.26	792 46	1, 303 69
966, 696	43, 294	25, 607	1, 319, 201	219, 867	4, 790 70	3.63	798 45	1, 666 24
254, 621	59, 691	24, 021	1, 480, 026	246, 671	4, 568 90	3.09	761 48	1, 716 90
272, 718	50, 697	31, 126	1, 506, 754	215, 251	6, 204 87	4.12	886 41	1, 942 28
360, 110	97, 042	30, 913	1, 490, 085	212, 869	5, 165 25	3.45	737 89	833 00
184, 444	17, 365	31, 669	931, 022	232, 757	4, 483 87	4.82	1, 120 97	1, 929 88
773, 169	111, 415	97, 213	2, 680, 552	382, 936	5, 163 10	1.92	737 59	4, 249 31
726, 249	128, 817	55, 140	2, 772, 455	346, 557	5, 933 26	2.14	741 66	3, 820 92
140, 994	28, 806	14, 409	906, 910	151, 152	4, 519 43	3.98	753 24	1, 547 46
544, 643	95, 347	65, 992	2, 657, 875	241, 625	8, 730 77	4.22	923 70	6, 926 76
177, 507	23, 901	6, 199	532, 265	133, 066	3, 006 92	5.67	751 73	705 66
1, 568, 270	367, 357	177, 262	7, 089, 185	253, 185	23, 198 41	3.27	888 51	11, 577 75
534, 368	68, 671	68, 477	2, 624, 313	187, 451	11, 455 33	3.36	818 24	4, 198 48
806, 805	151, 723	101, 581	3, 474, 566	315, 870	8, 914 60	2.46	810 42	6, 987 66
213, 338	52, 226	17, 867	956, 464	191, 293	3, 303 14	3.45	660 63	845 23
132, 538	25, 739	34, 964	1, 081, 277	216, 255	3, 907 90	3.61	781 58	821 91
604, 985	72, 370	43, 015	1, 885, 822	235, 728	6, 586 52	3.49	823 31	1, 696 68
281, 404	45, 906	27, 226	1, 014, 389	202, 878	3, 314 20	3.26	662 84	690 43
1, 534, 998	475, 714	227, 492	7, 236, 688	241, 232	27, 386 14	3.64	912 87	9, 745 44
706, 415	66, 998	48, 353	2, 025, 969	202, 597	7, 470 13	2.32	747 01	3, 622 04
345, 212	82, 727	35, 167	1, 418, 897	202, 700	6, 368 78	4.50	912 68	1, 611 80
302, 071	73, 692	111, 172	1, 660, 637	332, 127	6, 199 93	3.73	1, 239 99	1, 251 85
762, 539	113, 427	91, 922	3, 049, 016	234, 540	9, 806 44	3.22	745 50	2, 610 87
1, 717, 172	339, 159	209, 915	7, 080, 439	272, 325	24, 933 28	3.38	958 97	15, 008 37
499, 977	90, 867	54, 095	1, 990, 176	220, 020	7, 260 90	3.66	806 77	3, 337 18
420, 850	68, 615	131, 374	1, 275, 376	212, 563	3, 857 32	3.02	642 89	1, 839 40
560, 058	117, 764	87, 051	2, 676, 708	267, 671	9, 072 83	3.39	907 28	2, 538 00
1, 032, 899	204, 398	124, 163	4, 947, 320	206, 138	22, 062 06	4.46	918 25	11, 250 77
309, 089	48, 220	14, 444	1, 512, 717	216, 102	5, 569 31	3.68	795 62	1, 865 39
723, 566	77, 913	68, 431	2, 642, 542	188, 753	11, 850 50	4.43	846 46	10, 162 58
2, 224, 968	379, 834	679, 531	6, 245, 899	132, 891	39, 928 55	6.39	849 54	10, 626 59
57, 562, 359	6, 896, 415	4, 812, 111	143, 040, 255	333, 427	375, 368 26	2.62	874 96	993, 240 22
578, 968	113, 806	50, 195	1, 621, 842	270, 307	4, 492 90	2.77	748 82	1, 671 88
319, 448	78, 142	31, 106	1, 475, 542	245, 924	4, 639 83	3.14	773 30	2, 639 87
294, 390	53, 564	25, 866	1, 072, 181	178, 697	4, 708 27	4.39	784 71	913 84
962, 572	43, 614	28, 222	1, 129, 629	161, 376	5, 611 62	4.81	801 69	1, 713 40
579, 655	155, 622	61, 098	1, 866, 999	235, 875	6, 188 14	3.22	773 52	1, 461 57
225, 580	51, 177	22, 682	967, 502	193, 500	3, 495 54	3.67	699 11	544 83
26, 900, 635	4, 649, 993	4, 837, 424	84, 992, 249	344, 098	231, 645 61	2.72	937 84	294, 329 22
1, 774, 105	283, 689	189, 225	6, 728, 127	194, 857	27, 728 24	4.18	815 54	18, 105 52
1, 825, 623	169, 799	90, 462	2, 470, 133	247, 013	8, 783 95	3.55	878 39	3, 525 85
1, 422, 410	26, 844	49, 661	5, 833, 539	208, 385	2, 895 20	3.47	723 80	1, 087 14
639, 367	100, 824	138, 034	2, 081, 204	346, 967	4, 341 54	5.08	723 59	1, 884 93
567, 222	78, 155	21, 240	2, 789, 849	139, 492	16, 584 45	2.09	829 22	13, 749 14
311, 623	97, 911	41, 503	1, 545, 206	220, 744	5, 727 78	3.61	818 25	1, 429 44
361, 002	68, 802	34, 239	1, 732, 292	192, 477	7, 496 97	4.33	833 00	2, 035 62
910, 122	177, 374	103, 322	3, 306, 475	206, 655	12, 527 51	2.76	782 97	3, 532 05
2, 221, 862	161, 809	171, 817	6, 875, 835	298, 949	17, 940 62	2.60	780 03	10, 015 90
473, 183	116, 746	113, 187	2, 054, 030	293, 433	4, 899 20	2.38	699 89	2, 154 36
7, 031, 849	1, 411, 819	1, 951, 020	27, 043, 402	252, 742	98, 539 92	3.64	920 93	38, 164 59

† Seven carriers at this office until June 1, 1876.

*Statement of the operations of the free-delivery system*

Post-offices.	Number of carriers in service June 30, 1876.	Delivered.					
		Mail.		Local.		Registered letters.	Newspapers.
		Letters.	Postal cards.	Letters.	Postal cards.		
Saint Paul, Minn.....	10	886, 488	173, 472	54, 251	40, 940	9, 608	578, 402
Salem, Mass.....	6	355, 974	54, 310	36, 913	32, 171	8	315, 131
San Francisco, Cal.....	42	3, 099, 257	216, 532	1, 222, 402	612, 008	11, 399	1, 340, 611
Savannah, Ga.....	6	484, 197	81, 797	70, 720	19, 687	2, 294	222, 314
Springfield, Mass.....	8	798, 839	108, 000	104, 387	32, 770	1, 232	308, 980
Springfield, Ill.....	5	378, 400	74, 476	22, 881	15, 943	1, 228	231, 219
Syracuse, N. Y.....	17	1, 787, 567	234, 266	177, 002	135, 151	7, 291	902, 883
Toledo, Ohio.....	15	1, 419, 327	135, 019	118, 719	87, 411	6, 170	612, 473
Trenton, N. J.....	6	421, 376	45, 742	40, 305	21, 681	899	252, 554
Troy, N. Y.....	15	1, 727, 519	241, 262	197, 318	90, 841	3, 819	803, 995
Utica, N. Y.....	13	1, 105, 397	192, 150	120, 063	60, 078	5, 215	512, 143
Washington, D. C.....	37	2, 611, 478	213, 434	344, 711	132, 438	6, 999	1, 341, 801
Wheeling, W. Va.....	6	666, 979	121, 727	41, 073	19, 953	6, 628	352, 613
Wilmington, Del.....	10	647, 153	86, 773	73, 776	43, 956	1, 704	317, 258
Worcester, Mass.....	11	706, 310	108, 485	96, 610	72, 418	31	348, 625
Total aggregates and averages.....	2, 269	189, 659, 443	23, 952, 381	53, 773, 933	19, 963, 290	1, 069, 699	80, 675, 040
Salary of special agents of the Post-Office Department paid out of appropriations for letter-carriers							
Total.....							

# REPORT OF THE POSTMASTER-GENERAL.

187

for the year ended June 30, 1876—Continued.

Collected.			Pieces handled.		Cost of service, (including incidental expenses.)			Postage on local matter.
Letters.	Postal cards.	Newspapers.	Aggregate.	Per carrier.	Aggregate.	Per piece.	Per carrier.	
732,030	157,442	73,965	2,706,588	270,659	\$7,462 42	<i>Mills.</i> 2.75	\$746 24	\$2,735 02
279,496	53,770	44,223	1,171,996	193,333	5,211 68	4.45	868 61	1,540 63
4,945,292	683,634	838,052	12,969,187	308,790	41,307 98	3.26	983 52	63,525 76
421,596	69,398	34,022	1,413,025	235,504	4,127 00	2.21	687 83	2,690 89
456,651	81,747	49,423	1,942,629	242,754	6,121 85	3.15	765 23	3,622 49
223,089	62,540	58,364	1,068,790	213,758	3,625 35	3.44	737 07	959 17
1,083,933	218,634	165,040	4,722,367	277,786	14,188 53	3.00	634 62	5,331 45
1,196,025	274,453	198,733	4,049,330	260,955	12,637 77	3.12	842 52	4,785 76
347,375	47,266	33,104	1,216,302	202,717	4,656 24	3.22	776 04	1,759 68
1,412,359	203,315	334,116	5,014,544	334,303	12,056 37	2.40	603 76	5,717 05
897,830	187,747	95,706	3,176,329	244,333	11,094 00	3.49	853 39	3,943 31
1,823,325	222,842	224,976	6,982,004	188,703	34,929 55	5.00	944 04	20,226 41
558,186	108,916	62,434	1,938,509	323,085	4,322 76	2.23	720 46	1,349 81
307,153	76,790	15,339	1,569,899	156,990	8,012 73	5.10	801 27	2,703 26
444,549	92,492	45,612	1,915,332	174,121	9,323 31	4.86	847 57	5,784 39
204,280,079	33,950,503	28,453,086	631,777,473	.....	1,976,486 85	3.13	.....	2,065,561 73
from July 1, 1875	.....	.....	.....	.....	4,699 66	.....	.....	.....
.....	.....	.....	.....	.....	1,981,186 51	.....	.....	.....



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**ANNUAL REPORT**  
**OF THE**  
**AUDITOR OF THE TREASURY**  
**FOR THE**  
**POST-OFFICE DEPARTMENT**  
**TO THE POSTMASTER-GENERAL**  
**FOR THE**  
**FISCAL YEAR ENDED JUNE 30, 1876.**

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OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT,

October 23, 1876.

SIR: I have the honor to submit the following annual report of the receipts and expenditures of the Post-Office Department, together with the operations of this office in connection therewith, for the fiscal year ended June 30, 1876.

*Collection of post-office revenues.*

The number of post-offices in operation during the year was 36,495 which are classified, under the regulations adopted for the government of the Department, chapter 25, sections 352 to 368, inclusive, as follows: special offices, depositing offices, depository and draft offices, and collection offices.

The following-named offices are denominated depositories or draft offices, and are required by the Postmaster-General to receive and retain, subject to the drafts of the Department, the funds of certain adjacent offices, as well as the revenues of their own, viz :

Adrian, Mich., J. H. Fee.  
Albany, N. Y., J. F. Smyth.  
Albia, Iowa, J. H. Morris.  
Atlanta, Ga., Benj. Conley.  
Auburn, N. Y., J. B. Richardson.  
Augusta, Me., H. H. Hamlin.  
Austin, Tex., H. B. Kinney.  
Bangor, Me., A. B. Farnham.  
Batavia, N. Y., Wm. Tyrrell.  
Bay City, Mich., T. C. Phillips.  
Binghamton, N. Y., E. B. Stephens.  
Burlington, Vt., B. J. Derby.  
Charleston, Ill., J. A. Miles.  
Cleveland, Ohio, N. B. Sherwin.  
Columbus, Ohio, J. M. Comly.  
Concord, N. H., J. E. Larkin.  
Decorah, Iowa, A. K. Bailey.  
Denver, Colo., E. C. Sumner.  
Des Moines, Iowa, J. S. Clark.  
Detroit, Mich., J. H. Kaple.  
Dubuque, Iowa, G. L. Torbert.  
East Saginaw, Mich., T. Saylor.  
Elmira, N. Y., C. G. Fairman.  
Evansville, Ind., T. R. McFerson.  
Fort Dodge, Iowa, N. M. Page.  
Fort Wayne, Ind., J. J. Kamm.  
Grand Rapids, Mich., A. B. Turner.  
Harrisburgh, Pa., M. W. McAlarey.  
Hartford, Conn., J. H. Burnham.  
Houghton, Mich., F. A. Douglas.  
Houston, Tex., T. H. Scanlon.  
Huntsville, Ala., J. D. Sibley.  
Indianapolis, Ind., W. R. Holloway.  
Iowa City, Iowa, M. H. Brainard.  
Jacksonville, Fla., M. Govin.  
Jamestown, N. Y., A. M. Clark.  
Kalamazoo, Mich., L. B. Kendall.  
Keene, N. H., A. Smith.  
Keokuk, Iowa, J. C. Parrott.  
Knoxville, Tenn., Wm. Rule.

La Fayette, Ind., J. L. Miller.  
Lansing, Mich., S. D. Bingham.  
Leavenworth, Kans., D. R. Anthony.  
Lexington, Ky., H. K. Milward.  
Lima, Ohio, C. Parmenter.  
Louisville, Ky., L. M. Porter.  
Madison, Wis., E. W. Keyes.  
Malone, N. Y., J. J. Seaver.  
Marquette, Mich., S. M. Billings.  
Marshalltown, Iowa, E. N. Chapin.  
Meadville, Pa., L. D. Williams.  
Memphis, Tenn., J. Deloach.  
Milwaukee, Wis., H. C. Payne.  
Mobile, Ala., T. C. Bingham.  
Montgomery, Ala., J. J. Martin.  
Montpelier, Vt., J. W. Clark.  
Mount Pleasant, Iowa, G. W. McAdam.  
Nashville, Tenn., H. W. Hasslock.  
Newark, N. J., W. Ward.  
New Bedford, Mass., T. Coggeshall.  
New Haven, Conn., N. D. Sperry.  
Norwich, N. Y., E. B. Barrett.  
Ogdensburg, N. Y., R. G. Pettibone.  
Olean, N. Y., J. G. Johnson.  
Omaha, Nebr., C. E. Yost.  
Peoria, Ill., J. S. Stevens.  
Pittsburgh, Pa., E. C. Negley.  
Plattsburgh, N. Y., H. S. Ransom.  
Portland, Me., C. W. Goddard.  
Portsmouth, N. H., E. G. Pierce.  
Portsmouth, Ohio, L. Adair.  
Providence, R. I., C. R. Brayton.  
Raleigh, N. C., W. W. Holden.  
Richmond, Va., E. L. Van Lew.  
Rochester, N. Y., D. T. Hunt.  
Rutland, Vt., A. H. Tuttle.  
Saint Albans, Vt., B. D. Hopkins.  
Saint Johnsbury, Vt., C. P. Carpenter.  
Saint Paul, Minn., David Day.  
Sandusky, Ohio, J. M. Boalt.

Savannah, Ga., J. G. Clark.  
 Scranton, Pa., J. A. Scranton.  
 Springfield, Ill., J. L. Crane.  
 Steubenville, Ohio, J. M. Reed.  
 Springfield, Mass., H. C. Lee.  
 Syracuse, N. Y., A. C. Chase.  
 Taunton, Mass., E. E. Fuller.  
 Terre Haute, Ind., N. Fillbeck.  
 Toledo, Ohio, P. H. Darling.  
 Towanda, Pa., S. W. Alvord.

Urbana, Ohio, D. C. Hitt.  
 Utica, N. Y., C. H. Hopkins.  
 Watertown, N. Y., W. G. Williams.  
 Wellsborough, Pa., G. W. Merrick.  
 Wheeling, W. Va., C. J. Rawling.  
 Williamsport, Pa., R. Hawley.  
 Winona, Minn., D. Sinclair.  
 Wooster, Ohio, A. S. McClure.  
 Worcester, Mass., J. Pickett.  
 Zanesville, Ohio, J. C. Douglas.

The following officers receive and retain, subject to the warrants of the Post-Office Department, the funds of such post-offices as are instructed to deposit in their hands, viz:

*The Treasurer of the United States, at Washington, D. C.—The Assistant Treasurers of the United States at*

New York, N. Y.  
 Baltimore, Md.  
 New Orleans, La.  
 Cincinnati, Ohio.  
 Saint Louis, Mo.

Philadelphia, Pa.  
 Boston, Mass.  
 Charleston, S. C.  
 Chicago, Ill.  
 San Francisco, Cal.

One hundred post-offices are draft offices, and during the year paid 19,446 drafts, issued by the Postmaster-General, countersigned, entered, and sent out by the Auditor, for sums in the aggregate of.....	\$1, 668, 000 14
Twenty-six hundred and sixty-six are deposit offices, a portion of which during the year deposited with the Treasurer and Assistant Treasurers of the United States the sum of .....	4, 361, 107 34
Thirty-one thousand six hundred and eighty-seven offices are collection offices, and paid on collection-orders issued to mail-contractors the sum of.....	4, 373, 136 26
Two thousand two hundred and fifteen offices are special offices, and derive their mail supplies by the payment of the revenue of their offices therefor, amounting to.....	52, 174 49
Three thousand eight hundred and seventy-nine post-offices are supplied by mail-messengers, for which service there was paid during the year.....	632, 648 03

### *Revenue account of the Post-Office Department.*

The receipts of the Department for the fiscal year ended June 30, 1876, were .....	\$23, 644, 197 50
The amount placed in the Treasury for the service of the Department for the fiscal year, being grants in aid of the revenue, under the following acts of Congress, were:	
Under the second section of the act approved March 3, 1875, for mail-steamship service between San Francisco, Japan, and China.....	\$500, 000 00
Under the second section of the act approved March 3, 1875, for mail-steamship service between the United States and Brazil .....	37, 500 00
Under the act approved June 12, 1876, private No. 51, to pay Jackson T. Sorrells for carrying the mails in North Carolina in 1865 .....	53 80
Under the first section of the act approved March 3, 1871, for supplying deficiency in the revenue of the Post-Office Department for the fiscal year ended June 30, 1871.....	14, 146 38
Under the third section of the act approved March 3, 1871, for supplying deficiency in the revenue of the Post-Office Department for the fiscal year ended June 30, 1872 .....	3, 393 98
Under the third section of the act approved June 23, 1874, for supplying deficiency in the revenue of the Post-Office Department for the fiscal year ended June 30, 1875.....	533, 488 87



Under the third section of the act approved March 3, 1875, for supplying deficiency in the revenue of the Post-Office Department for the fiscal year ended June 30, 1876 ..... \$4,000,000 00

\$5,088,583 03

Aggregate of revenues and grants ..... 33,732,780 53  
The expenditures of the Department for the fiscal year ended June 30, 1876, were ..... 33,263,487 58

Excess of receipts ..... 469,292 95

The balance standing to the credit of the revenue account at the close of the fiscal year ended June 30, 1876, was ..... \$2,591,851 06  
Add amount of credits balance accounts closed by "suspense" to close of fiscal year ..... 332,406 20

Total ..... 2,924,257 26  
Deduct amount of debit balances closed by "bad debt" and "compromise" accounts to close of fiscal year... 966,768 64

Leaving to the credit of the revenue account..... \$1,957,488 62  
This amount includes all balances now in suit and in the hands of postmasters.

*The net revenue of the Department from postages, being the aggregate of balances due the United States by postmasters on the adjustment of their quarterly accounts for the year, after deducting their compensation and the expenses of their offices, was :*

For the quarter ended September 30, 1875 ..... \$3,661,106 53  
For the quarter ended December 31, 1875 ..... 4,026,296 89  
For the quarter ended March 31, 1876 ..... 4,221,410 06  
For the quarter ended June 30, 1876 ..... 3,786,053 19  
Total ..... 15,694,866 67

*The amount of letter-postages paid in money was :*

For the quarter ended September 30, 1875 ..... \$49,539 24  
For the quarter ended December 31, 1875 ..... 58,937 79  
For the quarter ended March 31, 1876 ..... 65,548 97  
For the quarter ended June 30, 1876 ..... 50,766 37  
Total ..... 224,792 37

*The amount of stamps, stamped envelopes, newspaper and periodical stamps, postal cards, and newspaper-wrappers sold was :*

For the quarter ended September 30, 1875 ..... \$6,286,129 29  
For the quarter ended December 31, 1875 ..... 6,832,277 81  
For the quarter ended March 31, 1876 ..... 7,002,974 39  
For the quarter ended June 30, 1876 ..... 6,758,130 61  
Total ..... 26,879,512 10

*The amount of official stamps furnished the different Departments, and included in the above amount of stamps sold, was :*

To the Executive Office ..... \$600 00  
To the Department of State ..... 3,060 00  
To the Navy Department ..... 14,460 00  
To the War Department ..... 80,486 93  
To the Agricultural Department ..... 1,400 00  
To the Interior Department ..... 100,960 00  
To the Department of Justice ..... 3,476 00  
To the Treasury Department ..... 97,900 00  
To the Post-Office Department ..... 979,046 50  
Total ..... 1,281,389 43

*The number of quarterly returns of postmasters received and audited, on which the sum of \$15,694,866.67 was found due the United States, was :*

For the quarter ended September 30, 1875 .....	35,525
For the quarter ended December 31, 1875 .....	35,687
For the quarter ended March 31, 1876 .....	35,669
For the quarter ended June 30, 1876 .....	36,006
<b>Total .....</b>	<b>142,887</b>

#### MAIL-TRANSPORTATION.

The amount charged to transportation accrued and placed to the credit of mail-contractors and others for mail-transportation during the year, was :

For the regular service of mail-routes .....	\$15,099,250 76
For the supply of special and mail-messenger offices .....	684,822 53
For the salaries of postal-railway clerks, route and other agents .....	2,412,867 70
For the salaries and per diem of the assistant superintendents of the postal-railway service .....	46,402 01
<b>Total .....</b>	<b>\$18,243,343 02</b>

#### FOREIGN-MAIL TRANSPORTATION.

San Francisco, Japan, and China .....	\$502,531 23
United States and Brazil .....	37,561 96
New York, Great Britain, and Ireland .....	91,896 64
New York, England, France, and Germany .....	30,798 57
New York, England, and Bremen .....	28,659 80
New York, San Francisco, and South American States, via Panama .....	16,033 74
New York and Great Britain .....	13,656 58
New York, Philadelphia, England, France, and Germany ..	8,064 74
New York, Havana, New Orleans, and Vera Cruz .....	12,895 89
New York and West Indies .....	7,448 76
Chicago, Detroit, Portland, and Great Britain .....	3,603 05
New York and Glasgow .....	2,246 72
New York, West Indies, Brazil, and Argentine Republic ..	1,204 34
Boston, Great Britain, and Ireland .....	2,976 99
Philadelphia and Queenstown .....	1,996 06
France and United States .....	1,742 94
New York and South American States, via Aspinwall .....	1,621 72
Portland and Nova Scotia .....	790 23
New York and Bermuda .....	779 02
New Orleans, Key West, and Havana .....	686 80
Baltimore, Brazil, Argentine Republic, and West Indies ..	404 86
Boston and Nova Scotia .....	254 47
New Orleans and Havana .....	215 14
Philadelphia, Havana, and New Orleans .....	207 86
New York and Venezuela, via West Indies .....	242 03
Cleveland and Canada .....	133 09
New York and Argentine Republic .....	78 84
Baltimore and Bremen .....	20 71
Key West and Havana .....	17 28
Boston and Great Britain .....	3 14
New York and Rotterdam .....	2 92
Expenses of Government mail-agent at Panama .....	1,528 80
Expenses of Government mail-agent at Aspinwall .....	940 00
Expenses of Government mail-agent at Havana .....	800 00
	<b>772,044 92</b>
	<b>19,015,387 94</b>

The amount credited to transportation accrued, and charged to contractors for overcredits, was :

For fines imposed.....	\$3,981 04	
For deductions .....	116,218 76	
		\$120,199 80
Net amount to the credit of mail-contractors and others.....	18,895,188 14	
The amount actually paid during the year was.....	\$18,604,386 95	

## STATEMENT OF COLLECTING DIVISION.

This division has had charge of 24,760 accounts of postmasters who became late during the period from July 1, 1874, to June 30, 1876.

Amounts collected from postmasters becoming late prior to July 1, 1875 :

Collected by draft .....	\$20,245 75
Collected by suit.....	21,201 99
Credited on vouchers.....	74,796 38
Charged to suspense.....	40 26
Charged to bad debts.....	41,922 17
Charged to compromise debts.....	908 32
Total.....	259,114 87

Number of changes of postmasters reported by appointment-office during the fiscal year was 9,497 ; and the balances due the United States upon the accounts of said late postmasters amounts to..... \$193,094 46

Of which there has been—

Collected by draft.....	\$88,403 71
Credited on vouchers.....	224 45
Charged to suspense.....	211 56
Charged to bad debts.....	297 49
	69,137 21
Total remaining due.....	103,957 25
Of which there is—	
In suit.....	\$376 81
Not in suit.....	103,580 44
	103,957 25

Amount reported due late postmasters, late prior to July 1, 1875 :

As per last report.....	\$85,002 04
Decrease during the fiscal year.....	1,298 85

Amount remaining due.....	83,703 19
Amount paid thereon.....	\$51,856 76
Amount closed by suspense.....	5,573 35
Amount remaining due June 30, 1876 .....	26,273 08
	83,703 19
Amount due postmasters late during the fiscal year.....	\$38,047 63
Amount paid thereon.....	\$11,383 46
Amount closed by suspense.....	270 97
Amount remaining due.....	26,393 20
	38,047 63

Amount due by late postmasters for which suit has been brought during the fiscal year.....	\$70,139 07
Amount collected by suit during the fiscal year.....	21,201 99

The subjoined tables, numbered from 1 to 38, inclusive, exhibit in detail the transactions of the Department for the fiscal year.

I have the honor to be, very respectfully,

J. M. MCGREW, Auditor.

HON. JAS. N. TYNER,  
Postmaster-General.

No. 1.—*Statement exhibiting quarterly the receipts of the Post-Office Department, under their several heads, for the fiscal year ended June 30, 1876.*

Receipts.	Quarter ended September 30, 1875.	Quarter ended December 31, 1875.	Quarter ended March 31, 1876.	Quarter ended June 30, 1876.	Aggregate.
Letter-postage .....	\$49,539 24	\$58,937 79	\$65,548 97	\$50,766 37	\$224,792 37
Book, newspaper, and pamphlet postage.....	148 50	48 69	13 87	.....	211 06
Box-rents and branch offices.....	330,607 39	325,963 73	321,478 70	327,877 23	1,305,927 05
Fines and penalties.....	756 05	1,028 13	989 77	584 06	3,358 01
Postage-stamps, stamped envelopes, and postal cards .....	6,286,129 29	6,832,277 81	7,002,974 39	6,758,130 61	26,879,512 10
Dead letters.....	2,866 53	4,380 17	893 00	1,749 50	9,889 20
Revenue from money-order business.....	.....	.....	.....	190,770 84	190,770 84
Miscellaneous .....	7,735 71	7,974 78	6,739 25	7,287 13	29,736 87
<b>Total .....</b>	<b>6,677,782 71</b>	<b>7,230,611 10</b>	<b>7,398,637 95</b>	<b>7,337,165 74</b>	<b>28,644,197 50</b>

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, *October 23, 1876.*

J. M. MCGREW, *Auditor.*

No. 2.—Statement exhibiting quarterly the expenditures of the Post-Office Department, under their several heads, for the fiscal year ended June 30, 1876.

Expenditures.	Quarter ended September 30, 1875.	Quarter ended December 31, 1875.	Quarter ended March 31, 1876.	Quarter ended June 30, 1876.	Aggregate.	Paid for pre- paid letters but included in aggregate.
Compensation of postmasters	\$1,777,353 76	\$1,825,059 83	\$1,931,130 00	\$1,863,854 32	\$7,397,397 91	\$15,937 49
Compensation of clerks for post-offices	864,423 11	864,970 19	854,852 43	896,484 42	3,480,730 13	763 90
Compensation of letter-carriers and incidental expenses	490,951 02	497,399 97	497,304 53	495,139 50	1,980,795 02	
Wrapping-paper	3,177 22	8,304 96	3,412 50	3,412 50	18,207 02	
Twine	10,046 40	12,939 39	11,474 50	4,253 00	38,718 29	
Postmarking and canceling stamps	2,592 05	1,711 37	2,776 73	1,841 75	8,857 90	
Letter-balances	677 56	2,123 64	5 13	1,101 06	3,907 39	
Rent, light, and fuel for post-offices	96,579 09	98,309 53	98,301 77	107,239 38	390,428 77	
Stationery	11,554 31	9,753 37	11,798 69	10,236 56	43,312 83	
Furniture for post-offices	19,125 73	4,971 00	3,930 01	19,699 37	19,699 37	
Miscellaneous, office of First Assistant Postmaster-General	19,125 73	17,561 18	14,394 18	25,011 57	76,022 66	
Inland mail transportation	3,734,067 96	3,827,899 35	3,564,207 48	3,619,651 16	14,745,545 95	484,343 35
Compensation of railway post-office clerks	287,216 39	296,528 31	319,628 56	330,377 03	1,233,750 19	
Compensation of route agents	230,209 06	238,065 59	242,034 04	239,819 28	940,151 97	
Compensation of mail-route messengers	38,278 28	35,959 09	36,288 89	36,625 41	147,132 37	
Compensation of local agents	25,028 21	25,531 09	25,456 71	25,745 26	101,813 37	
Compensation of mail-messengers	152,568 01	160,321 19	161,067 10	153,691 73	627,648 03	
Mail locks and keys	901 25	10,892 30	3,916 15		15,709 70	
Mail bags and catchers	34,286 77	62,395 25	64,009 83	45,825 64	206,517 49	29 40
Post-route maps	8,855 60	8,378 46	6,528 86		23,662 92	
Mail depredations and special agents	36,831 71	33,620 40	35,919 66	12,305 17	118,676 94	
Postage-stamps	28,468 43	28,466 16	52,711 71	11,141 78	120,788 08	
Distribution of postage-stamps	2,067 35	1,508 50	969 74	486 26	5,050 85	
Stamped envelopes and newspaper-wrappers	102,886 98	109,444 82	109,027 69	30,228 65	358,600 14	
Distribution of stamped envelopes and newspaper-wrappers	3,205 43	9,929 48	2,825 28	1,260 97	10,021 16	
Postal cards	58,050 10	53,392 59	56,016 42	13,663 68	182,122 79	
Distribution of postal cards	1,760 34	771 08	1,076 10	430 32	4,027 84	
Registered-package envelopes, locks, and seals	1,350 66	6,790 29	11,076 03	12,830 61	32,167 59	
Official envelopes for postmasters	3,735 95	2,878 40	5,242 48	3,566 48	15,423 31	
Dead-letter envelopes		2,783 00	696 00	800 40	9,270 40	
Ship, steamboat, and way letters	1,329 43	971 70	844 17	926 53	4,071 83	
Fees to United States marshals, attorneys, clerks of court, and counsel	743 98	1,192 37	2,001 74	965 29	4,903 28	
Engraving, printing, and binding drafts and warrants	376 25	408 95	2,001 74	1,751 00	4,537 94	
Advertising	30,910 98	19,458 56	4,026 25	32,459 35	86,855 14	
Miscellaneous, office of Third Assistant Postmaster-General	361 73	173 58	474 15	611 05	1,620 51	
Foreign mail transportation	52,844 57	65,033 12	60,557 86	50,682 71	229,123 96	
Balance due foreign countries	94,728 76	3,723 70	4,395 21	3,876 14	103,553 80	25,051 85
Official Postal Guides	6,500 62	2,965 52	6,515 64	2,971 05	18,052 83	
Additional compensation of postmasters, 1873-'74, set March 2, 1875	769 65	370 78	42 00		1,175 43	
Subsidy—San Francisco, Japan and China, and Brazil lines	168,500 00	125,000 00	125,000 00	125,000 00	537,500 00	
Total	8,310,319 30	8,465,411 99	8,392,706 28	8,165,050 07	33,263,467 58	467,301 42

OFFICE OF THE AUDITOR OF THE TREASURY FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

J. M. MCGREW, Auditor.

## No. 3.—Statement of the postal receipts and expenditures of

States and Territories.	Letter-postage.	Book, newspaper, and pamphlet postage.	Waste-paper and twine.	Box-rents and branch offices.	Postage-stamps, stamped envelopes, and postal cards.	Total receipts.
Maine	\$2,559 64		\$119 68	\$24,128 60	\$422,296 50	\$449,104 42
New Hampshire	480 86		152 62	14,228 06	262,299 31	277,136 85
Vermont	416 16		152 21	10,632 86	241,920 08	253,121 31
Massachusetts	11,113 61	\$37 34	806 69	92,930 18	1,871,740 88	1,982,718 70
Rhode Island	1,030 69		126 33	20,896 50	197,284 34	219,337 86
Connecticut	2,691 53		233 28	37,450 58	569,721 94	610,097 33
New York	82,101 07	6 42	3,344 92	184,650 19	5,334,467 36	5,604,570 02
New Jersey	3,126 90		177 35	25,414 09	554,656 05	581,374 39
Pennsylvania	16,633 70		1,199 20	87,489 26	2,381,324 11	2,664,646 27
Delaware	288 48		16 23	1,307 42	66,761 79	67,473 92
Maryland	8,311 42	1 40	107 57	10,411 56	493,985 95	512,817 96
Virginia	2,167 92	7 16	96 43	12,007 14	391,683 37	405,962 02
West Virginia	792 71		124 03	3,274 90	132,507 54	136,699 15
North Carolina	597 72	1 25	68 65	7,749 99	185,817 36	194,234 97
South Carolina	718 72		57 20	7,458 22	158,940 06	167,174 26
Georgia	1,705 16	11 00	141 24	19,006 99	292,010 52	312,874 91
Florida	946 42		19 20	4,752 92	69,066 85	74,825 51
Ohio	5,606 98	11 86	1,263 92	78,830 86	1,766,129 69	1,851,843 21
Michigan	6,192 41	78 22	602 95	62,900 42	818,963 93	888,737 93
Indiana	2,512 53	1 75	552 59	45,302 95	732,106 22	740,462 05
Illinois	13,658 50	6 23	2,625 91	103,251 25	2,136,232 01	2,255,773 90
Wisconsin	3,701 19		362 10	44,862 04	611,756 94	660,622 27
Iowa	3,685 35		443 85	60,788 64	76,324 91	81,242 75
Missouri	5,421 71		785 45	30,899 32	917,232 25	954,338 73
Kentucky	1,521 66	7 35	241 15	16,056 06	419,093 38	436,919 60
Tennessee	1,196 56	80	143 42	10,388 51	292,236 94	309,966 23
Alabama	1,197 33	48 01	48 00	13,095 59	202,288 32	216,677 25
Mississippi	670 41	1 05	60 15	13,042 49	153,451 57	167,225 67
Arkansas	301 28	12 58	42 32	8,242 32	115,503 89	124,102 39
Louisiana	3,667 40	13 60	94 05	20,992 80	254,535 08	279,302 93
Texas	3,309 68		196 16	36,523 29	379,378 25	417,407 32
California	7,695 47	14 72	223 12	60,261 26	740,904 38	809,098 95
Oregon	117 12		43 26	9,441 64	76,702 44	86,304 46
Minnesota	3,804 05	2 70	223 51	22,836 05	326,154 70	353,021 01
Kansas	1,147 33		167 63	25,164 37	311,652 92	338,132 25
Nebraska	654 78		76 03	11,028 74	157,439 79	169,259 34
Nevada	414 11		28 21	13,993 83	65,060 73	79,497 56
Colorado	444 58		154 83	19,343 73	107,379 02	127,362 16
Utah	293 28		67 64	5,279 52	64,904 46	70,544 90
New Mexico	71 50		11 26	1,525 15	17,910 52	19,518 43
Washington	73 05		13 91	2,095 13	34,470 67	36,679 75
Dakota	144 59		6 60	1,638 73	28,273 73	30,063 65
Arizona	21 62		15 25	965 90	10,980 09	11,968 92
Idaho	53 57		23 45	2,106 90	14,658 37	16,842 29
Wyoming	59 38		18 45	2,626 63	41,227 97	43,932 43
Montana	62 25		12 96	5,430 69	24,299 74	30,405 64
Alaska	5 01		1 00	8 00	352 47	366 48
District of Columbia	2,445 63		63 60	6,378 34	175,886 63	184,774 20
Deduct miscellaneous items	205,913 90	263 44	15,627 52	1,305,150 79	25,606,496 06	27,133,451 71
Add miscellaneous items	18,878 47	52 38		776 26	1,273,016 04	1,292,618 39
	224,792 37	211 06	15,627 52	1,305,927 05	26,879,512 10	28,426,070 10

NOTE.—The following items of expenditure and revenue, being of a general nature, are not embraced

Amount paid for foreign mails and expenses of Government agents	\$766,623 26
Balances due foreign countries	33,253 20
Ship, steamboat, and way letters	4,071 83
Wrapping-paper	18,207 02
Twine	38,718 29
Office-furniture	1,113 30
Advertising	73,395 38
Mail bags and catchers	176,512 12
Salary and per diem of assistant superintendents of postal-railway service	46,402 01
Mail locks and keys	15,709 70
Postmarking and canceling stamps	8,857 90
Mail depredations and special agents	118,676 84
Letter-balances	3,907 32
Expenses of postage-stamps, stamped envelopes, and postal cards	680,610 86
Dead-letter, official, and registered envelopes, locks, and seals	49,870 30
Additional compensation to postmasters for year ended June 30, 1874. Act of Mar. 3, 1875	1,175 43
Sundry and miscellaneous payments	56,011 22
Excess of expenditures brought down	3,076,075 97

the United States for the fiscal year ended June 30, 1876.

Compensation of postmasters.	Clerks for office, rent, light, and fuel, and incidental expenses of post-offices.	Compensation of letter-carriers.	Compensation of route-agents, postal-railway clerks, mail-messengers, and supply of special offices.	Transportation by States.	Total expenses.	Excess of expenditures over receipts.	Excess of receipts over expenditures.
\$179,343 62	\$48,544 50	\$12,231 25	\$46,808 44	\$232,654 11	\$519,581 92	\$70,477 50	
123,516 89	12,965 73	6,199 93	23,995 50	99,224 30	271,902 35		\$5,234 53
121,903 36	15,689 29		22,044 97	152,159 80	317,797 42	64,676 11	
380,454 11	328,404 44	174,003 72	121,673 60	432,420 92	1,496,956 79		485,761 91
44,042 70	27,047 73	16,584 45	8,014 96	46,918 91	142,608 75		76,729 11
186,522 65	27,356 08	20,581 27	55,150 84	199,440 03	534,030 87		76,046 46
769,630 25	1,107,231 34	578,737 87	386,772 58	1,370,623 81	4,232,995 85		1,371,574 17
200,785 20	46,404 76	56,119 59	31,495 64	235,022 21	569,820 40		13,553 99
623,616 47	352,350 95	298,038 64	198,196 76	640,852 16	2,313,054 96		373,591 29
22,639 39	5,592 36	8,012 73	8,735 42	30,073 17	75,053 07	6,579 09	
90,780 29	86,432 57	57,445 96	38,798 30	360,334 96	633,792 08	120,974 12	
153,099 30	52,628 19	20,515 95	40,280 45	405,651 22	674,175 11	268,213 09	
93,380 24	14,167 97	4,322 76	18,028 23	136,887 75	235,796 95	99,097 77	
92,715 88	18,712 43		40,619 42	231,639 86	383,687 59	129,452 62	
73,145 03	13,826 42	5,882 43	17,700 06	126,315 03	266,868 97	69,694 71	
115,817 40	48,962 32	8,481 00	50,856 89	288,699 45	512,817 06	199,942 15	
34,614 02	6,546 05		13,198 36	119,076 08	173,434 51	98,609 00	
496,265 35	903,456 51	128,008 79	256,027 83	1,281,425 22	2,465,183 70	613,340 49	
331,551 33	97,722 90	34,411 50	75,642 40	448,924 36	988,252 49	99,514 56	
300,438 91	89,050 54	36,829 90	123,827 33	432,763 85	982,910 53	202,428 48	
561,772 66	425,645 08	162,448 89	342,870 83	1,085,660 40	2,598,497 86	342,723 96	
255,018 87	64,311 94	24,933 28	82,635 20	360,327 93	787,227 22	126,544 95	
357,384 59	65,988 01	18,938 92	137,298 94	519,422 01	1,098,731 47	247,488 72	
330,923 80	158,325 14	112,353 72	130,675 93	693,689 73	1,333,968 32	379,609 59	
137,655 22	47,658 18	30,147 84	47,549 47	275,869 08	538,879 79	101,960 19	
97,826 14	47,347 35	18,881 27	90,193 78	241,793 97	506,042 51	196,076 28	
105,763 30	27,169 89	3,857 32	33,138 51	276,850 15	436,779 17	220,101 92	
91,921 32	13,869 40		14,272 96	283,572 66	403,636 34	236,410 67	
64,892 56	14,083 34		14,119 96	264,091 97	357,187 83	233,085 44	
51,552 84	72,529 23	39,928 55	19,309 83	237,617 68	420,938 13	141,635 20	
168,073 24	55,077 75		35,526 74	513,875 94	772,553 67	353,146 29	
177,052 31	114,208 75	41,307 98	66,908 19	492,045 60	891,522 83	82,423 88	
38,039 76	10,319 10		10,427 50	136,724 04	195,510 40	109,205 94	
142,480 56	37,766 19	14,723 32	59,105 12	269,157 43	523,232 62	170,211 61	
163,475 16	36,080 94	3,314 20	67,777 67	291,831 53	562,479 59	224,347 25	
75,476 60	19,079 21	4,639 83	69,004 07	369,347 14	537,546 85	368,287 51	
37,393 18	14,455 40		2,280 77	154,845 62	208,974 97	129,477 39	
52,299 59	22,184 47		10,889 60	158,662 40	244,036 06	116,673 90	
34,121 34	10,216 40		6,795 35	299,475 92	350,609 01	280,064 11	
12,693 29	1,703 53		7 33	156,644 14	171,048 29	151,529 46	
14,991 10	1,367 25		2,281 31	114,275 85	132,915 51	106,462 75	
17,193 96	1,812 05		328 33	81,492 01	100,826 35	70,762 70	
6,523 69	229 28			83,919 99	90,672 96	78,690 04	
10,926 61	1,181 00		87 88	86,408 18	98,603 67	81,761 38	
13,441 85	3,335 75		180 00	23,528 65	40,496 25		3,436 18
17,958 95	5,561 73		250 00	101,802 10	125,572 80	95,167 16	
223 07					223 07		143 41
7,397 10	111,068 70	34,929 55	114,720 25		268,115 60	83,341 40	
7,397,845 05	4,036,668 16	1,976,506 41	3,096,501 50	15,050,049 32	31,557,570 44	6,830,189 78	2,406,071 05
447 14				70,998 34	55,424 37		
	10,543 77	4,288 61	1,188 73				1,292,618 39
7,397,397 91	4,047,211 93	1,980,795 02	3,097,690 23	14,979,050 98	31,502,146 07	6,774,765 41	3,698,689 44

In the above statement, viz:

Receipts on account of dead-letters .....	\$9,889 20
Receipts on account of fines and penalties .....	3,358 01
Receipts on account of miscellaneous .....	14,109 35
Receipts on account of money-order business .....	190,770 84
Excess of transportation accrued .....	331,781 54
Total excess of expenditures over receipts .....	4,619,290 08

## REPORT OF THE POSTMASTER-GENERAL.

No. 4.—Comparative statement of receipts and expenditures of the Post-Office Department from July 1, 1836, to June 30, 1876.

Year.	Receipts.			Expenditure.
	Revenue.	Treasury grants.	Total.	
1837.....	\$4,945,668 21		\$4,945,668 21	\$3,288,319 03
1838.....	4,238,733 46		4,238,733 46	4,430,662 21
1839.....	4,484,656 70		4,484,656 70	4,636,536 31
1840.....	4,543,521 92		4,543,521 92	4,718,245 64
1841.....	4,407,726 27	\$482,657 00	4,890,383 27	4,499,527 61
1842.....	4,546,849 65		4,546,849 65	5,674,751 80
1843.....	4,296,225 43		4,296,225 43	4,374,753 71
1844.....	4,237,287 83		4,237,287 83	4,296,512 70
1845.....	4,289,841 80		4,289,841 80	4,320,731 99
1846.....	3,487,199 35	750,000 00	4,237,199 35	4,076,036 91
1847.....	3,880,309 23	12,500 00	3,892,809 23	3,979,542 10
1848.....	4,555,211 10	125,000 00	4,680,211 10	4,326,850 27
1849.....	4,705,176 28		4,705,176 28	4,479,049 13
1850.....	5,499,984 86		5,499,984 86	5,212,953 43
1851.....	6,410,604 33		6,410,604 33	6,278,401 68
1852.....	5,184,526 84	1,741,444 44	6,925,971 28	7,108,459 04
1853.....	5,240,724 70	2,255,000 00	7,495,724 70	7,982,756 59
1854.....	6,255,586 22	2,736,748 96	8,992,335 12	8,577,424 12
1855.....	6,642,136 13	3,114,542 26	9,756,678 39	9,968,342 29
1856.....	6,920,821 66	3,748,881 56	10,669,703 22	10,405,286 36
1857.....	7,353,951 76	4,528,004 67	11,881,956 43	11,508,057 93
1858.....	7,486,792 86	4,679,270 71	12,166,063 57	12,722,470 01
1859.....	7,968,484 07	3,915,946 49	11,884,430 56	11,458,083 63
1860.....	8,518,067 40	11,154,167 54	19,672,234 94	19,170,609 89
1861.....	8,349,296 40	4,639,806 53	12,989,102 93	13,606,759 11
1862.....	8,299,820 90	2,598,953 71	10,898,774 61	11,125,364 13
1863.....	11,163,789 59	1,007,848 72	12,171,638 31	11,314,206 84
1864.....	12,438,253 78	749,980 00	13,188,233 78	12,644,786 20
1865.....	14,556,158 70	3,968 46	14,560,127 16	13,694,738 28
1866.....	14,436,986 21		14,386,986 21	15,352,079 30
1867.....	15,297,026 87	3,991,666 67	19,228,693 54	19,235,463 46
1868.....	16,292,600 80	5,696,525 00	21,989,125 80	22,730,562 65
1869.....	18,344,510 72	5,707,115 30	24,051,626 02	23,698,131 50
1870.....	19,772,220 65	4,022,140 85	23,794,361 50	23,998,837 63
1871.....	20,037,045 42	4,126,200 00	24,163,245 42	24,390,104 08
1872.....	21,915,426 37	4,993,750 00	26,909,176 37	26,658,192 31
1873.....	22,996,741 57	5,990,475 00	28,987,216 57	29,084,945 67
1874.....	26,471,071 82	5,922,433 55	32,393,505 37	32,126,414 58
1875.....	26,791,360 59	6,704,646 96	33,496,007 55	33,611,309 45
1876.....	28,634,197 50	5,088,583 03	33,722,780 53	33,263,467 58

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

J. M. MCGREW, Auditor.

No. 5.—Statement in detail of miscellaneous payments made by the Post-Office Department for the fiscal year ended June 30, 1876, exhibiting the sums placed to the credit of postmasters and others, and charged to "miscellaneous account, First Assistant Postmaster-General."

Date.	To whom allowed.	For what object.	Amount.
1876. Mar. 30	A. J. Myer.....	Chief Signal-Officer, U. S. A., for telegraphing on account of special agent Charles Adams, while in charge of the post-office at Prescott, Ariz., in September and October, 1875.	\$9 42
Apr. 19	Thomas P. Cheney.....	Assistant superintendent of railway mail-service, for telegrams on account of railway mail-service for the month of March, 1876.	11 29
20	James E. White.....	Assistant superintendent of railway mail-service, for telegrams on account of railway mail-service for the month of March, 1876.	13 46
20	A. C. Jackson.....	Assistant superintendent railway mail-service, for telegrams, stationery, and fuel on account of railway mail-service for the month of March, 1876.	105 13
20	J. A. Amerman.....	Assistant superintendent railway mail-service, for rent, office-furniture, and stationery on account of railway mail-service for the month of March, 1876.	171 19



No. 5.—Statement of miscellaneous payments by the Post-Office Department, &amp;c.—Continued.

Date.	To whom allowed.	For what object.	Amount.
1876.			
Apr. 20	W. L. Hunt.....	Assistant superintendent railway mail-service, for telegrams, stationery, printing, mounting maps, and official railway-guides on account of railway mail-service for the month of March, 1876.	\$38 80
27	Theo. N. Vail.....	General superintendent of railway mail-service, for telegrams, stationery, and printing on account of railway mail-service for the months of January, February, and April, 1876.	8 90
27	M. V. Bailey.....	Special agent Post-Office Department, for sundry telegrams.	4 48
May 5	W. L. Hunt.....	Special agent Post-Office Department, for railway-guides, printing, and telegrams during the month of April, 1876.	35 05
8	R. C. Jackson.....	Special agent Post-Office Department, for telegrams, fuel, stationery, and printing for the month of April, 1876.	47 70
10	Thomas P. Cheney.....	Special agent Post-Office Department, for telegrams and stationery for the month of April, 1876.	33 55
10	J. A. Amerman.....	Superintendent railway mail-service, for rent, telegrams, and stationery for the month of April, 1876.	103 32
16	James E. White.....	Superintendent railway mail-service, for telegrams for the month of April, 1876.	4 38
29	Warren Choate.....	For 2 reams of carbon paper furnished for use of the railway mail-service in the month of May, 1876.	18 00
June 5	W. L. Hunt.....	Special agent Post-Office Department, for telegrams and stationery during the month of May, 1876.	34 79
5	C. Jay French.....	Special agent Post-Office Department, for telegrams, railway-fare, and cleaning office of superintendent of railway mail-service for months of April and May, 1876.	18 62
6	Thomas P. Cheney.....	Special agent Post-Office Department, for telegrams, stationery, and printing for the month of May, 1876.	41 50
6	James E. White.....	Special agent Post-Office Department, for telegrams in month of May, 1876.	3 91
8	M. V. Bailey.....	Special agent Post-Office Department, for telegrams, repairs of safe, and putting up letter-boxes during the month of May, 1876.	14 76
9	R. C. Jackson.....	Special agent Post-Office Department, for telegrams, stationery, fuel, railway-fare, and printing during the month of May, 1876.	67 07
10	J. A. Amerman.....	Superintendent of railway mail-service, for rent of office, and telegrams during the month of May, 1876.	50 00
July 8	E. M. Whitaker.....	For stationery furnished for railway mail-service in month of June, 1876.	887 50
8	W. L. Hunt.....	Special agent Post-Office Department, for mounting map, telegrams, official railway-guides, and stationery for the month of June, 1876.	192 60
8	Theo. N. Vail.....	General superintendent of railway mail-service, for printing, stationery, and skeleton maps for month of June, 1876.	180 00
8	L. M. Terrell.....	Superintendent of railway mail-service, for telegrams, railway-fare, printing, and stationery for the month of June, 1876.	79 40
10	J. A. Amerman.....	Superintendent of railway mail-service, for office-rent, telegrams, and stationery for the months of May and June, 1876.	352 02
10	Theo. N. Vail.....	General superintendent railway mail-service, for telegrams and printing for the month of June, 1876.	6 90
12	R. C. Jackson.....	Special agent Post-Office Department, for drawing in reducing to scale plan for postal-car, telegrams, and stationery, printing, and lettering mail-box, for the month of June, 1876.	341 24
17	L. M. Terrell.....	Special agent Post-Office Department, for telegrams, cleaning and care of office, and stationery, for the month of June, 1876.	66 06
19	James E. White.....	Special agent Post-Office Department, for telegrams, railroad-fare, and stationery, for the month of June, 1876.	85 16
26	Thomas P. Cheney.....	Assistant superintendent railway mail-service, for telegrams and stationery for the month of June, 1876.	24 53
Sept. 16	Union Pacific Railroad Co..	For transmission of telegraphic dispatches during the year 1875.	75 86

No. 5.—*Amounts paid by the Department on drafts, First Asst. P. M. Gen'l., miscellaneous.*

Date.	To whom allowed.	For what object.	Amount.
1876. April 20	William B. Thompson.....	Assistant superintendent railway mail-service, for telegrams, stationery, map-bracket, and spring fixtures, on account of railway mail-service.	\$63 56
May 10	William B. Thompson.....	Special agent Post-Office Department, for telegrams and stationery in the month of April, 1876.	47 23
12	C. Jay French .....	Special agent Post-Office Department, for telegrams and printing, for months of February, March, and April, 1876.	81 26
15	L. M. Terrell .....	Special agent Post-Office Department, for telegrams for month of March, 1876.	32 32
21	William B. Thompson.....	Assistant superintendent railway mail-service, for telegrams, stationery, office-key, and moving goods belonging to the fast mail, for month of May, 1876.	153 49
July 8	William B. Thompson.....	Special agent Post-Office Department, for telegrams, hardware, stationery, printing, and lumber, for the month of June, 1876.	177 46
15	C. J. French .....	Special agent Post-Office Department, for telegrams, stationery, gas-bill, railroad-fare, and printing, for month of June, 1876.	49 72

*Amounts credited postmasters on their general accounts, First Asst. P. M. Gen'l., miscellaneous.*

1875. Nov. 30	Lillie Fisk .....	Postmaster at Galena, Mo., for traveling-expenses per order.	\$2 00
Dec. 4	J. C. Douglass .....	Postmaster at Zanesville, Ohio, for stationery, 3d quarter 1875.	7 50
17	S. P. Gamble .....	Postmaster at San Antonio, Tex., for safe.	575 00
1876. Feb. 2	Leander Colt .....	Postmaster at Suspension Bridge, N. Y., 3d and 4th quarters 1875, and 1st quarter 1876, for miscellaneous items.	49 48
10	J. C. Whittlesey .....	Late postmaster at Houston, Tex., for amount paid for removal of office-furniture and boxes from Galveston to Houston.	70 00
16	John L. Miller .....	For balance on dating-stamp, 3d quarter 1875.	4 00
March 2	Leslie Bassett .....	Postmaster at Richland, Iowa, for hire of team.	3 00
16	J. W. Rich .....	Postmaster at Vinton, Iowa, for mailing-table and stamping-pad.	17 50
16	J. S. Adams .....	Postmaster at Jacksonville, Fla., for miscellaneous expense, 3d quarter 1875.	9 07
23	James E. Dunham .....	Postmaster at Bridgeport, Conn., miscellaneous expense, 4th quarter 1875.	31 39
31	William L. Burt.....	Late postmaster at Boston, Mass., for letter-slips, 4th quarter 1875.	101 23
May 8	Lucy J. Fowler.....	Postmaster at Cedar Keys, Fla., for fire-proof safe.	465 00
17	J. W. Bissell .....	Postmaster at Duncansby, Miss., for recovery of property of post-office at Holland's Landing, Miss.	12 00
July 3	Thomas L. James .....	Postmaster at New York City, for expenses incurred in fitting up rooms for the use of the department.	345 71
Aug. 19	J. L. Crane .....	Postmaster at Springfield, Ill., for city directory.	3 00
28	William Jackson.....	Late postmaster at Rock Island, Ill., for printing, 1st quarter 1876.	2 40

No. 5.—*Amounts allowed to the postmasters at the principal offices of the United States, for incidental expenses of such offices actually and necessarily incurred, such as office-repairs, gas-fixtures, telegraphing, and other miscellaneous expenses, and charged to miscellaneous account, First Assistant Postmaster-General.*

Third quarter, 1875 .....	\$18,936 33
Fourth quarter, 1875 .....	17,266 00
First quarter, 1876 .....	12,653 72
Second quarter, 1876 .....	22,169 65
<b>Total</b> .....	<b>71,017 69</b>
Amount paid to postmasters and others .....	1,698 28
Amount paid by warrants .....	3,126 50
Amount paid by drafts .....	605 04
<b>Total</b> .....	<b>76,447 60</b>
Deduct amounts charged to postmasters for overcredits .....	\$385 00
Deduct amount of fares charged to inland transportation .....	39 94
	<b>424 94</b>
<b>Amount actually paid, and charged to miscellaneous account .....</b>	<b>76,022 66</b>

No. 5.—*Statement in detail of miscellaneous payments on warrants, made by the Post-Office Department for the fiscal year ended June 30, 1876, and charged to miscellaneous account, Third Assistant Postmaster-General.*

Date.	To whom allowed.	For what object.	Amount.
1875.			
Dec. 10	W. & J. Sloane.....	For carpet furnished for the office of the stamp-agent at New York, in the month of October, 1875.	\$68 72
10	G. Ebbinghausen & Co.....	For furniture furnished for the office of the stamp-agent at New York, in the month of November, 1875.	245 00
1876.			
Feb. 11	George G. Pride .....	Stamp-agent, for traveling-expenses from New York to Washington and return, on business connected with postage-stamp agency at New York, January 24 and 26, 1876.	34 50
Feb. 17	A. D. Hazen .....	Chief of stamp-division, Post-Office Department, for expenses incurred in going to New York and Philadelphia, on business for the Post-Office Department, in February, 1876.	37 25
Mar. 29	Mohun Brothers .....	For 10 yards of roll drawing-paper, furnished to the Post-Office Department in the month of March, 1876.	5 00
May 19	E. H. Purdy & Co.....	For frames, glass, boxes, easels, packing, and fitting up for the Post-Office Department in the month of May, 1876.	390 40
July 1	A. D. Hazen .....	Chief of stamp-division, Post-Office Department, for personal expenses incurred during sundry trips on official business to Philadelphia and New York, from February 21 to May 28, 1876.	241 75
8	Continental Bank Note Co..	For mounting and framing postage-stamps for display at the Centennial Exhibition at Philadelphia.	250 00
Aug. 17	George G. Pride .....	Stamp-agent, for expenses incurred in traveling from New York to Washington on official business, April 4 to 7 and May 23 to 25, 1876.	67 80
1875.			
Oct. 13	A. D. Hazen .....	Chief of stamp-division, for expenses to New York and Springfield, Mass., on official business.	69 58

No. 5.—*Amounts paid by the Department on drafts and charged to miscellaneous account.*

Date.	To whom allowed.	For what object.	Amount.
1876.			
Jan. 26	P. Jewel & Sons .....	For 40 pounds of lap-splits, furnished for the use of the postal-card agency at Springfield, Mass.	\$4 00
Mar. 10	M. S. Perry .....	For expenses to and from New York on business for the Post-Office Department.	20 75
24	Howell, Firm & Co .....	For mounting sample stamped envelopes for exhibition at the Centennial.	2 50
May 12	E. W. Barber .....	Third Assistant Postmaster-General, for expenses incurred from May 1 to May 6, 1875, inclusive, in making arrangements for the manufacture of Centennial stamped envelopes.	45 00
June 7	H. T. Sperry .....	For expenses at Philadelphia and Washington, on Post-Office Department business, during the month of May, 1876.	38 75
July 15	George N. Tyner.....	Postal-card agent, for expenses incurred while traveling on official business for the Post-Office Department from June 2 to June 6, 1876.	51 50
<i>Amount credited on general account.</i>			
1875.			
Nov. 9	Thomas B. Van Buren .....	United States consul and mail-agent at Yokohama, Japan, for miscellaneous expenses.	48 01
	Total miscellaneous,	Third Assistant Postmaster-General .....	1,620 51

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

## REPORT OF THE POSTMASTER-GENERAL

No. 6.—Statement showing the transactions of the Money-Order Office of the United States during the fiscal year ended June 30, 1876.

States and Territories.	Domestic.					International.							
	Balance from last year.	Number of orders issued.	Amount of orders issued.	Fees.	Premium.	Drafts and deposits received from postmasters.	Transferred from postage fund.	Canadian.			British.		
								Number of orders.	Amount of orders.	Fees.	Number of orders.	Amount of orders.	Fees.
Alabama.....	\$18,401 55	69,637	\$1,196,516 67	\$9,474 95	\$304 15	\$754,856 88	\$3,216 70	19	\$650 60	\$15 10	77	\$1,557 75	\$44 75
Arizona.....	11,417 62	5,706	200,442 53	1,130 40		1,000 00	610 00	4	175 00	3 60	43	1,564 70	40 75
Arkansas.....	14,636 02	51,315	1,239,723 39	8,210 25	197 21	565,586 00	711 00	4	40 00	1 20	45	1,209 97	33 90
California.....	25,654 73	117,350	2,050,924 86	13,838 50		1,515,149 00	4,588 53	497	13,027 61	305 20	2,633	51,472 73	1,558 40
Colorado.....	13,603 65	35,773	670,543 89	5,002 00		367,309 00	3,060 35	28	667 61	15 00	1,968	47,248 85	1,295 25
Connecticut.....	9,697 53	78,832	1,119,578 25	9,961 70		366,939 00	15,057 28	238	5,122 54	117 00	2,146	32,625 79	1,048 00
Dakota Ter.....	1,222 85	10,539	206,591 86	1,518 80		5,400 00	287 00	10	234 64	5 20	11	269 41	6 25
Delaware.....	1,784 93	11,390	166,027 53	1,444 65		6,465 00	6,687 04	10	234 64	5 20	130	2,263 54	71 25
District of Columbia.....	14,027 18	30,491	557,338 89	4,155 00		1,280,876 80	3,309 88	93	1,929 13	46 00	508	8,040 72	270 73
Florida.....	25,654 64	36,695	931,726 58	6,213 00		1,779,729 00	9,914 65	103	3,862 99	78 40	148	5,085 34	134 75
Georgia.....	50,016 59	79,510	1,240,405 40	10,384 90	3 72	6,696,382 00	4,377 00	1	2,715 92	58 40	246	6,193 41	169 50
Idaho Ter.....	5,619 63	197,697 47	1,076 85			66,692 00	914 65	103	2,715 92	58 40	246	6,193 41	169 50
Illinois.....	84,711 96	526,240	7,083,293 47	65,099 45		6,698,382 00	43,665 92	495	9,474 84	221 95	3,584	59,032 79	1,830 00
Indiana.....	40,198 96	246,465	3,211,316 45	30,036 90	111 06	1,192,493 77	31,066 27	68	1,053 24	26 00	201	13,536 54	405 25
Iowa.....	181 97	813	30,859 89	133 70		1,773,633 80	13,049 40	66	1,440 32	33 20	591	9,003 42	292 60
Kansas.....	57,371 06	333,493	4,586,137 87	41,637 85		790,413 70	6,526 48	23	601 77	13 40	296	5,746 16	163 50
Kentucky.....	23,133 97	141,425	2,219,725 81	18,605 90		849,389 00	7,861 58	24	946 73	21 60	340	6,427 63	192 25
Louisiana.....	13,803 15	83,914	1,947,455 06	10,796 13		1,750,218 00	4,225 00	612	1,985 02	49 20	290	6,761 64	185 50
Maine.....	40,132 02	50,028	1,143,688 53	7,695 15		1,507,408 00	8,595 44	219	4,473 74	103 90	1,550	33,298 72	896 85
Maryland.....	20,312 11	76,956	1,339,576 50	10,390 60	67	1,237,236 00	4,373 87	60	1,413 30	31 80	621	9,819 17	306 85
Massachusetts.....	24,709 66	177,195	9,837,671 65	23,146 40		1,665,314 20	57,398 85	1,836	40,233 94	921 20	6,411	105,575 13	3,297 85
Michigan.....	50,311 34	359,011	3,683,959 01	32,301 45		1,712,817 00	13,057 91	775	15,008 13	347 80	2,686	46,398 44	1,367 90
Minnesota.....	26,297 14	118,568	1,747,639 90	15,173 20		637,174 82	897 62	45	274 72	20 60	294	4,223 67	132 75
Mississippi.....	32,856 12	91,390	1,661,750 07	12,691 40	964 45	19,509 09	1,635 66	14	241 03	7 40	83	1,532 39	45 50
Missouri.....	23,323 13	107,908	3,056,500 09	25,946 00	121 16	98,807 00	13,130 63	115	2,263 24	52 80	1,029	20,166 47	586 65
Montana Ter.....	8,746 93	8,863	173,391 94	1,287 40		930,946 00	9,164 16	23	591 05	12 60	93	3,017 25	70 75
Nebraska.....	20,549 33	63,680	1,090,738 40	6,714 05									
Nevada.....	5,057 17	14,909	399,385 46	2,499 95									
New Hampshire.....	6,772 81	49,934	715,919 07	6,309 55									
New Jersey.....	9,027 20	62,661	909,520 04	8,130 10	0 43	95,543 74	4,945 12	119	1,020 72	44 35	697	10,539 07	320 25
New York.....	1,302 3	1,302 3	1,302 3	1,302 3									

	7,955	210,913 45	1,359 00	170 04	104,793 37	3	21 50	870 00	14,930	401 75	9 00
New Mexico, Ter.....	3-7, 730	5,764,220 31	40,522 60	170 04	15,937,011 06	11,877	38,047 34	870 00	14,930	255,124 00	7,505 50
New York.....	84,485	1,010,506 31	11,942 55	...	2,243,950 00	4,035 47	38,470 40	10 40	74	2,048 45	56 25
North Carolina.....	377,392	4,867,031 93	45,990 65	...	2,985,000 23	354	0,101 48	145 40	2,674	43,117 48	1,350 50
Ohio.....	20,172	3,393,541 28	2,970 15	...	343,351 00	1,529 00	0,697 34	16 80	2,692	8,158 49	219 00
Oregon.....	274,763	3,742,324 13	33,890 30	114 60	2,716,464 70	51,392 34	11,304 69	257 70	6,003	91,673 81	2,000 10
Pennsylvania.....	25,910	4,6,222 97	3,392 95	...	14,259 00	1,575 00	2,899 65	66 80	1,474	25,600 53	2,003 25
Rhode Island.....	53,355	925,752 32	7,311 50	...	515,190 00	1,456 52	2,636 51	13 40	38	651 64	19 50
South Carolina.....	99,319	1,849,191 71	14,004 35	...	1,619,316 80	4,164 61	21,456 75	10 60	228	4,252 20	134 25
Tennessee.....	122,050	2,551,361 97	14,14 15	2-35	1,484,401 04	18,025 95	1,640 73	19 85	415	7,635 75	236 75
Texas.....	10,264	241,543 62	1,608 20	...	130,892 00	8,345 96	313 00	6 40	507	4,252 20	289 50
Utah, Ter.....	52,760	732,583 24	6,594 95	...	102,892 00	8,345 96	1,041 80	27 30	351	5,574 45	175 25
Vermont.....	78,847	1,253,369 24	10,376 50	...	1,444,708 00	5,881 77	532 48	12 25	608	10,504 89	388 00
Virginia.....	9,311	254,696 97	1,603 00	...	3,242 00	3,396 00	1,250 50	27 30	79	13,765 04	59 00
Washington, Ter.....	25,693	418,562 81	3,665 95	...	62,635 00	9,510 13	77 03	2 30	166	3,147 39	94 50
West Virginia.....	246,568	3,641,834 66	30,783 05	...	2,144,686 00	1,246 00	5,343 62	121 40	834	12,647 35	390 00
Wisconsin.....	10,964	256,452 64	1,703 45	...	...	...	1,155 00	3 30	49	12,623 90	26 25
Wyoming, Ter.....	...	...	...	...	...	...	...	...	...	...	...
Total.....	4,998,600	77,035,972 78	645,699 40	1,322 12	61,088,565 82	606,692 19	186,995 74	4,284 85	59,083	1,018,355 15	31,256 10

No. 6.—Statement showing the transactions of the Money-Order Office of the United States during the fiscal year ended June 30, 1876—Continued.

States and Territories.	International—Continued.				Domestic.				Transferred to postage fund.	Deposits.		
	German.		Swiss.		Balance due postmasters.	Number of orders paid.	Amount of orders paid.	Amount of orders repaid.				
	Number of orders.	Amount of orders.	Fees.	Number of orders.							Amount of orders.	Fees.
Alabama.....	240	\$6,914.30	\$182.30	2	\$25.00	\$0.75	\$188.06	31,519	\$594,975.31	\$7,031.65	\$3,010.00	\$1,362,293.04
Arizona.....	5	200.00	5.25				37.01	1,250	47,714.41	1,427.95		149,720.00
Arkansas.....	77	1,515.90	41.80				31.37	19,600	518,630.13	6,930.98		1,138,503.66
California.....	2,046	54,846.31	1,500.70	92	2,991.60	66.25	31.37	55,845	1,433,196.92	12,820.24		2,195,915.00
Colorado.....	123	2,889.00	82.40	6	235.50	6.25	22.00	30,903	496,466.59	5,644.56		590,318.00
Connecticut.....	536	8,622.87	269.45	39	978.00	26.50	51.96	64,776	1,077,540.39	5,695.24		1,355,709.02
Dakota.....	21	334.50	9.75				9.35	3,133	72,113.93	1,353.73		135,925.80
Delaware.....	30	810.14	22.40	2	50.00	1.25	4.62	7,749	133,738.01	844.35		46,913.00
District of Columbia.....	434	10,522.93	285.30	99	2,302.02	64.00	37,422	689,276.96	3,969.12	2,969.12		1,230,383.00
Florida.....	55	1,322.50	34.65	3	116.00	3.00	58.57	15,837	397,332.58	5,592.38		1,230,490.71
Georgia.....	367	11,497.57	302.85	22	803.40	28.75	6.40	64,598	1,144,007.06	7,796.10		1,175,841.40
Idaho.....	30	1,290.25	32.90					7,098	28,734.68	270.68		55,565.00
Illinois.....	3,774	69,481.41	1,916.35	424	9,518.82	286.25	692.96	674,088	8,855,153.77	45,463.41		4,976,321.74
Indiana.....	942	13,770.88	383.40	59	1,479.35	40.25	1,450.52	148,890	2,313,189.23	17,449.58		2,047,199.37
Indian Ter.....								85	2,068.89	60.80		16,975.00
Iowa.....	676	12,216.97	339.30	41	763.50	22.25	278.47	188,136	3,397,616.02	27,378.01		3,019,556.00
Kansas.....	111	2,280.24	62.45	4	115.00	3.25	51.41	95,396	1,805,633.19	15,011.77		1,177,355.34
Kentucky.....	430	10,522.82	294.15	26	603.95	21.50	103.33	82,025	1,477,571.38	9,552.65		1,177,355.34
Louisiana.....	292	6,390.73	174.55	19	440.00	12.25	51.08	51,035	1,974,035.20	5,910.62		624,563.18
Maine.....	109	3,129.86	82.65	21	858.00	21.25	164.93	65,593	1,176,969.91	6,507.35		1,621,169.00
Maryland.....	1,208	20,096.37	700.75	9	216.25	6.25	25.42	94,939	1,856,934.63	16,397.55		705,345.00
Massachusetts.....	1,123	34,104.02	662.30	75	1,295.11	38.25	175.93	311,863	4,019,756.69	16,397.55		335,508.10
Michigan.....	1,199	30,471.50	569.90	98	1,110.86	37.50	193.65	197,520	2,930,779.34	92,310.19		411,806.10
Minnesota.....	405	6,210.69	175.15	28	645.65	18.50	212.66	77,717	1,206,700.80	11,522.61		2,490,812.00
Mississippi.....	24	691.50	18.15	8	163.00	5.25	22.54	26,738	466,372.30	11,437.45		1,345,210.82
Missouri.....	1,053	23,861.90	643.80	84	2,568.66	69.25	203.12	277,916	5,125,651.37	19,932.39		1,239,660.03
Montana.....	44	1,223.00	32.05					9,312	60,741.90	1,068.90		2,394,768.56
Nebraska.....	159	2,920.50	78.85	3	84.75	2.25	28.78	38,598	909,573.96	6,827.82		1,303,573.00
Nevada.....	150	5,236.62	138.65	8	120.65	3.50	91.37	75,948	2,064,411.91	9,827.82		240,363.74
New Hampshire.....	92	1,619.34	45.70	4	69.25	1.00	146.95	35,490	542,183.97	3,359.72		255,863.78
New Jersey.....	1,425	26,795.14	739.95	43	990.95	20.00	169.04	58,590	936,496.00	5,054.65		255,863.78

New Mexico	16	530 50	14 00	1,700	44,304 50	1,301 25	553 12	1,589	44,470 97	1,703 93	42,878 30	71,743 30	335,654 37
New York	19,870	392,486 90	7,284 90	1,700	44,304 50	1,301 25	553 12	921,400 97	11,420,106 97	42,878 30	42,878 30	71,743 30	10,580,865 50
North Carolina	18,165	5,227 51	1,138 55	1	40 80	1 85	37 84	31,653	5,211,073 81	30,993 87	30,993 87	7,718 77	1,908,300 00
Ohio	2,969	39,178 97	1,080 90	101	1,738 65	51 75	437 43	405,015	5,211,073 81	30,993 87	30,993 87	104,520 89	2,452,509 67
Oregon	2,337	6,278 01	1,169 00	11	356 50	9 50	14 73	8,934	4,596,678 92	4,343 93	4,343 93	4,596,678 92	2,452,509 67
Pennsylvania	2,315	44,703 01	1,318 30	149	3,953 00	108 50	712 90	342,360	4,574,555 45	24,050 35	24,050 35	4,601 93	1,942,785 98
Rhode Island	1,140	3,101 95	83 65	2	30 00	50	95 69	17,171	309,652 93	2,195 06	2,195 06	1,916,902 00	1,916,902 00
South Carolina	65	1,829 00	42 85	1	35 00	1 00	.....	28,277	506,771 36	4,789 49	4,789 49	73 99	839,341 00
Tennessee	166	4,186 53	111 60	60	1,281 55	36 95	40 18	84,740	1,617,744 75	10,256 61	10,256 61	728 29	1,859,116 00
Texas	739	18,035 10	482 80	10	1,113 42	4 00	68 76	60,236	1,468,297 73	16,309 05	16,309 05	5,435 53	2,592,843 37
Utah	53	1,674 25	44 00	20	718 00	18 50	1 47	34,192	1,153,407 46	1,982 47	1,982 47	1,466 00	2,906,430 02
Vermont	17	713 40	18 00	20	708 70	18 50	103 59	63,486	1,191,144 90	1,596 51	1,596 51	13 41	1,594,559 00
Virginia	277	7,295 05	197 65	20	708 70	18 50	103 59	63,486	1,191,144 90	1,596 51	1,596 51	13 41	1,594,559 00
Washington	47	7,958 95	37 00	1	9 00	25	114 93	14,392	286,829 66	2,413 08	2,413 08	211 80	299,546 00
West Virginia	83	1,318 71	37 70	1	9 00	25	114 93	14,392	286,829 66	2,413 08	2,413 08	211 80	299,546 00
Wisconsin	1,546	23,347 44	689 55	102	1,661 45	49 50	279 21	159,546	2,833,917 19	21,437 55	21,437 55	873 46	2,920,956 00
Wyoming	9	245 75	7 00	.....	.....	.....	.....	9,689	119,556 64	1,832 56	1,832 56	.....	137,383 00
Total	38,174	780,060 52	21,448 10	3,457	83,256 62	2,347 25	6,740 97	4,947,593	76,632,571 45	473,767 40	473,767 40	594,589 68	62,071,210 02

## REPORT OF THE POSTMASTER-GENERAL.

No. 6.—Statement showing the transactions of the Money-Order Office of the United States during the fiscal year ended June 30, 1876—Continued.

States and Territories.	International.										Total.					
	Canadian.			British.			German.			Swiss.						
	Number of orders paid.	Amount of orders paid.	Amount of orders repaid.	Number of orders paid.	Amount of orders paid.	Amount of orders repaid.	Number of orders paid.	Amount of orders paid.	Amount of orders repaid.	Number of orders paid.		Amount of orders paid.	Amount of orders repaid.			
Alabama	9	\$327 85		35	\$759 18		51	\$1,303 95	\$10 00				\$306 28	\$121 65	\$16 867 75	\$63 47
Arizona					11 06		14	389 50						501 93	819 00	
Arkansas	6	935 83		17	332 45		53	1,583 97	10 00				1,721 49	3 663	23 679 48	4 16
California	367	11,000 79		480	10,076 54	\$75 50	678	17,910 98	224 50		5	\$130 54	10,307 44	10,307 44	22,991 74	88 16
Colorado	23	1,030 77		347	3,145 08	12 00	63	1,786 98			4	863 73	112 08	3,028 10	7,763 27	36 58
Connecticut	213	2,861 63		137	7,140 89	96 50	339	8,823 25	112 00		20	433 66	422 14	5,736 24	6,966 60	98 14
Dakota	3	117 71		12	240 88	5 00	59	1,467 20	32 25		6	227 86	12 50	683 09	3,735 88	22 17
Delaware	8	280 83		47	749 97		124	3,304 70					2 45	828 02	1,981 96	
District of Columbia	56	845 78		100	1,739 99	20 00	120	3,034 98	21 00	16	334 33		7,105 68	4,448 99	10,216 49	
Florida	18	463 32	\$67 00	31	725 10		10	239 00	25 00	2	66 94		627 22	6,099 32	21,618 52	1 83
Georgia	12	308 40		58	1,329 33		60	1,478 04	10 00	2	67 67		98 60	6,909 32	46,372 57	119 21
Idaho	5	169 60		12	305 42	20 00							18 95	446 07	3,313 15	5 40
Illinois	522	11,662 90	33 50	1,553	32,911 80	139 36	3,032	77,432 40	208 78	121	3,018 99	36 07	3,275 64	47,949 36	71,916 26	140 03
Indiana	120	2,531 14	20 00	272	5,765 09	245 75	580	14,649 95	147 00	30	867 64		3,464 69	15,296 51	30,703 83	161 28
Indian Ter.														49 73	90 44	
Iowa	127	3,327 72	24 00	336	7,539 29	57 00	1,317	32,650 25	61 35	74	230 62		107 35	20,927 18	56,172 10	106 76
Kansas	126	3,311 14		374	7,643 76		309	8,274 14		13	619 52		127 50	10,784 66	28,379 71	345 18
Kentucky	28	553 44		106	2,073 93	31 60	307	7,949 25		26	709 39		258 25	7,779 67	10,313 09	44 16
Louisiana	14	450 27	50 00	113	2,201 91		340	8,486 66	5 00	20	499 59		511 85	5,395 92	46,088 34	191 35
Maine	557	12,085 38		176	3,579 43		9	285 15		3	61 38		135 60	6,951 63	13,921 91	86 98
Maryland	62	881 42	26 30	211	3,541 71	66 00	542	12,991 52	170 50	17	494 57		312 49	20,333 24	18,543 24	174 10
Massachusetts	2,157	48,418 45	246 62	2,070	35,431 96	197 67	1,001	10,105 79	231 25	30	366 54	9 71	163 74	15,139 58	44,641 00	283 80
Michigan	529	18,097 43	168 07	1,778	26,865 68	235 68	1,101	26,865 68	151 91	50	1,398 55		35 30	7,998 82	27,207 98	1 78
Minnesota	133	3,269 53		172	3,535 71	10 00	1,179	32,360 56	179 65	10	226 85		25 30	5,439 71	27,703 30	
Mississippi	35	68 02		25	873 67		22	576 34		8	227 66		1,388 23	5,439 71	35,942 90	1 070 05
Missouri	128	3,166 97		439	9,016 34	111 75	1,675	43,159 75	140 70	04	668 56		789 09	21,334 47	8,096 88	
Montana	11	457 93		2	38 87		6	175 87					603 95	563 12	8,096 88	
Nebraska	43	1,360 32		198	4,017 95		478	12,801 78	37 00	28	931 97		61 55	5,251 18	22,501 34	95 34
Nevada	30	1,456 45	10 00	121	2,492 76		56	1,459 65					95 50	6,350 02	7,094 61	
New Hampshire	112	2,456 45		101	2,492 80		59	1,694 38					6 40	3,601 00	7,137 01	179 20
New Jersey	213	2,675 18	25 00	1,049	16,397 73	63 74	1,125	27,164 41	127 00	31	725 35		5 35	4,761 65	8,416 75	50 25



New Mexico.....	3, 894	01 00	525 40	5, 854	95, 150 63	733 30	7, 312	170, 314 78	57 10	773 50	350	8, 310 30	73 18	5, 605 40	505 60	6, 310 77	90 72
New York.....	11	50, 804 30	525 40	49	5, 854	95, 150 63	733 30	7, 312	170, 314 78	57 10	350	8, 310 30	73 18	5, 605 40	505 60	6, 310 77	90 72
North Carolina.....	454	8, 053 17	34 50	1, 121	21, 850 43	68 95	1, 718	44, 670 18	543 78	351 25	143	3, 997 95	16 00	2, 642 09	85, 740 74	22, 764 07	205 14
Ohio.....	132	4, 943 04	15	3, 031	48, 580 69	313 28	2, 480	61, 518 58	1, 900 11	73 80	138	3, 673 36	24 11	3, 683 56	21, 056 85	42, 546 62	451 00
Oregon.....	771	13, 385 19	56 00	283	5, 055 05	6 88	77	2, 059 71	2, 471 23	10 00	2	3, 673 36	24 11	3, 683 56	1, 900 50	14, 025 13	34 23
Pennsylvania.....	67	1, 465 58	90 00	32	5, 055 05	6 88	77	2, 059 71	2, 471 23	10 00	2	3, 673 36	24 11	3, 683 56	24, 211 51	42, 494 52	497 93
Rhode Island.....	37	900 13	.....	32	5, 055 05	6 88	77	2, 059 71	2, 471 23	10 00	2	3, 673 36	24 11	3, 683 56	1, 907 72	1, 450 32	4 04
South Carolina.....	14	352 97	.....	99	2, 523 14	90 00	90	2, 084 90	2, 471 23	57 00	3	1, 119 00	.....	16 80	3, 572 97	12, 516 06	.....
Tennessee.....	33	754 01	50 00	140	3, 004 81	55 00	44	1, 394 22	2, 084 90	135 00	16	484 74	.....	636 55	8, 406 50	29, 624 05	37 16
Texas.....	5	119 86	30 75	279	4, 194 23	55 00	44	1, 394 22	2, 084 90	135 00	16	484 74	.....	505 41	8, 971 76	10, 200 49	6 91
Utah.....	2, 062 58	.....	.....	46	874 91	5 49	1	11 25	.....	.....	.....	292 61	.....	121 91	3, 665 57	8, 563 34	119 17
Virginia.....	88	447 52	.....	198	4, 107 23	.....	107	2, 584 33	2, 584 33	.....	8	292 61	.....	121 91	6, 654 46	22, 065 60	21 52
Washington.....	34	639 23	10 00	7	131 15	33 30	41	1, 062 71	1, 062 71	43 00	22	498 46	.....	6 50	773 60	3, 508 57	.....
West Virginia.....	28	.....	.....	47	994 90	.....	41	837 39	837 39	.....	.....	498 46	.....	219 52	1, 579 86	6, 497 85	48 44
Wisconsin.....	5	102 62	.....	363	7, 775 20	128 00	2, 305	63, 356 49	63, 356 49	948 35	96	2, 411 71	34 83	128 26	16, 916 03	45, 554 61	209 53
Wyoming.....	150	1, 502 01	.....	11	145 63	.....	7	145 45	145 45	.....	.....	.....	.....	.....	875 35	3, 134 91	.....
Total.....	11, 783	224, 625 51	1, 447 14	20, 556	372, 288 63	2, 797 43	24, 879	720, 672 66	3, 601 38	1, 493	38, 304 29	309 79	33, 067 52	457, 940 23	1, 192, 536 80	3, 116 79	.....

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT,  
Washington, D. C., October 23, 1876.

No. 7.—*Statement of the receipts and disbursements of the Money-Order Office of the United States for the fiscal year ended June 30, 1876.*

## RECEIPTS.

Balance in the hands of postmasters June 30, 1875.....		\$1,258,979 16
Amount received for domestic money-orders issued...	\$77,035,972 78	
Amount received for Canadian international money-orders issued.....	186,995 74	
Amount received for British international money-orders issued.....	1,018,355 15	
Amount received for German international money-orders issued.....	780,060 52	
Amount received for Swiss international money-orders issued .....	83,256 62	
Total issued.....		79,104,640 51
Amount received for fees on domestic money-orders issued.....	645,699 40	
Amount received for fees on Canadian international money-orders issued.....	4,234 85	
Amount received for fees on British international money-orders issued.....	31,256 10	
Amount received for fees on German international money-orders issued.....	21,448 10	
Amount received for fees on Swiss international money-orders issued.....	2,347 25	
Total fees.....		705,035 70
Amount received for premiums, &c.....		1,322 12
Amount received for deposits and drafts.....		61,088,565 82
Amount transferred from postage fund.....		606,692 19
Amount due postmasters .....		6,740 97
		<hr/> 142,771,976 77

## DISBURSEMENTS.

Amount of domestic money-orders paid.....	\$76,632,571 45	
Amount of Canadian international money-orders paid.....	232,625 57	
Amount of British international money-orders paid...	372,288 63	
Amount of German international money-orders paid..	729,672 66	
Amount of Swiss international money-orders paid....	38,394 29	
Total paid.....		78,005,552 60
Amount of domestic money-orders repaid. \$473,767 40		
Amount of Canadian international money-orders repaid.....	1,447 14	
Amount of British international money-orders repaid.....	2,797 42	
Amount of German international money-orders repaid.....	3,691 38	
Amount of Swiss international money-orders repaid.....	203 79	
Total repaid .....		481,913 13
Amount transferred to postage-fund.....	524,589 68	
Amount deposited at first-class offices .....	62,071,210 02	
Amount paid for incidental expenses.....	33,067 52	
Amount paid for commissions and clerk-hire.....	457,940 23	
Miscellaneous items .....	5,166 79	
Balance in the hands of postmasters June 30, 1876....	1,192,536 80	
		<hr/> 142,771,976 77

J. M. MCGREW, *Auditor.*

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, *October 23, 1876.*

No. 8.—*Statement showing the revenue which accrued on domestic money-order transactions for the fiscal year ended June 30, 1876.*

Amount received for fees on orders issued .....	\$645,699 40	
Premiums, &c., received .....	1,322 12	
		647,021 52
Amount paid for commissions and clerk-hire .....	\$420,487 42	
Incidental expenses .....	30,800 09	
Lost remittances .....	4,960 64	
Bad debts .....	2 53	
Net revenue .....	190,770 84	
		647,021 52
	J. M. MCGREW,	Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 9.—*Statement showing the revenue which accrued on money-order transactions with the United Kingdom of Great Britain and Ireland for the fiscal year ended June 30, 1875.*

Amount of fees received on orders issued .....	\$34,986 25	
Amount paid for commissions and clerk-hire .....	\$23,036 12	
Excess of commissions paid United Kingdom .....	8,350 97	
Cost of exchange over treaty rates on £150,861 0s. 2d. ....	2,590 80	
Incidental expenses .....	174 77	
Net revenue .....	833 59	
		34,986 25
	J. M. MCGREW,	Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 10.—*Statement showing the revenue which accrued on money-order transactions with the German Empire for the fiscal year ended June 30, 1875.*

Amount received for fees on orders issued .....	\$20,498 25	
Gain in the purchase of exchange under treaty rates, on thalers 165,300..	39 30	
		20,537 55
Amount paid for commissions and clerk-hire .....	\$9,814 71	
Excess of commissions paid Germany .....	2,732 49	
Incidental expenses .....	173 88	
Net revenue .....	7,816 47	
		20,537 55
	J. M. MCGREW,	Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 11.—*Amount of letter-postage collected on French mails received in and sent from the United States during the fiscal year ended June 30, 1876.*

## RECEIVED.

Lines.	Unpaid distributed.	Unpaid.	Paid.	Paid distributed.	Total.
Inman line .....	\$1,338 70	\$467 25	.....	\$9,648 46	\$11,454 41
North-German Lloyd of Bremen .....	989 55	309 50	.....	6,796 93	8,095 98
Cunard line .....	603 09	360 94	.....	5,817 78	6,781 81
French Steamship Company .....	581 29	177 47	.....	3,970 43	4,729 19
Hamburg-American Packet Company .....	532 11	204 00	.....	4,071 65	4,807 76
<b>Total</b> .....	<b>4,044 74</b>	<b>1,519 16</b>	.....	<b>30,305 25</b>	<b>35,669 15</b>
<b>Amount received</b> .....	.....	<b>5,563 90</b>	<b>\$30,305 25</b>	.....	.....

## SENT.

Lines.	Paid.	Paid distributed.	Unpaid.	Total.
Cunard line .....	\$240 84	\$6,301 87	\$895 95	\$7,438 66
Hamburg-American Packet Company .....	493 92	4,774 47	1,232 66	6,501 05
Liverpool and Great Western Steam Company .....	24 84	5,072 79	999 25	6,096 88
French Steamship Company .....	165 24	3,710 99	549 41	4,425 64
White Star line .....	136 62	2,158 68	339 12	2,634 42
Inman line .....	105 84	1,951 10	398 95	2,455 89
North-German Lloyd, of Bremen .....	393 66	1,238 29	156 71	1,788 66
Anchor line .....	54	20 61	1 50	22 65
<b>Total</b> .....	<b>1,561 50</b>	<b>25,228 80</b>	<b>4,573 55</b>	<b>31,363 85</b>
<b>Amount sent</b> .....	<b>26,790 30</b>	.....	<b>4,573 55</b>	.....

Amount collected in the United States ..... \$32,354 20  
 Amount collected in France ..... 34,778 80

**Total** ..... **67,133 00**

Excess collected in France ..... 2,424 60  
 Increase compared with same period last fiscal year ..... 7,603 36

NOTE.—After France was admitted to the Postal Union, January 1, 1876, the postage was not reported.

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY

FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 12.—*Weight of letters and newspapers, &c., sent from the United States to the United Kingdom in British mails during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
Cunard line .....	15,686,146	63,987,616
White Star line .....	7,965,403	34,363,482
Hamburg-American Packet Company .....	7,697,651	33,931,794
Liverpool and Great Western Steam Company .....	7,493,792	33,007,552
North-German Lloyd of Bremen .....	1,651,709	14,416,185
Canadian line .....	1,820,597	9,180,350
Anchor line .....	889,370	5,533,601
American Steamship Company .....	539,896	3,516,843
Inman line .....	1,114,193	5,071,923
<b>Total</b> .....	<b>44,258,757</b>	<b>203,014,905</b>
<b>Decrease compared with last fiscal year</b> .....	<b>5,829,836</b>	<b>1,314,913</b>

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY

FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 13.—*Weight of letters and newspapers, &c., sent from the United States to Germany in closed mails through England and France, and by direct steamer, during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
North-German Lloyd of Bremen.....	8, 158, 393	29, 121, 761
Hamburg-American Packet Company, direct.....	7, 193, 179	27, 209, 833
Canard line, via England.....	4, 717, 146	19, 277, 297
Liverpool and Great Western Steam Company, via England.....	3, 946, 734	9, 507, 325
North-German Lloyd of Bremen, via England.....	1, 554, 394	3, 093, 974
Hamburg-American Packet Company, via England.....	1, 064, 995	754, 061
White Star line, via England.....	243, 839	560, 726
Anchor line, via England.....	132, 365	542, 727
Inman line, via England.....	56, 732	175, 461
American Steamship Company, via England.....	15, 250	79, 105
<b>Total</b> .....	<b>27, 085, 027</b>	<b>83, 922, 270</b>
Compared with last fiscal year.....	{ Increase..... Decrease.....	9, 210, 899
	49, 821	

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 14.—*Number and weight of letters, and weight of newspapers, &c., exchanged between the United States and France, during the fiscal year ended June 30, 1876.*

Lines.	Letters.				Newspapers, &c.	
	Received.		Sent.		Received.	Sent.
	<i>Rates.</i>	<i>Grams.</i>	<i>Rates.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>
Inman line.....	110, 320	812, 992	146, 758	333, 199	2, 0-3, 755	1, 0-0, 734
Hamburg-American Packet Company.....	46, 548	332, 635	71, 300	1, 222, 528	839, 845	4, 274, 431
North German Lloyd of Bremen.....	78, 560	569, 723	17, 890	336, 746	1, 907, 338	1, 202, 850
Canard line.....	66, 954	493, 336	81, 409	1, 793, 8-6	1, 011, 525	7, 430, 478
French line.....	35, 630	355, 385	48, 702	1, 047, 358	1, 355, 523	4, 449, 365
American Steamship Company.....			350	4, 527		18, 205
White Star Line.....			27, 362	740, 518		2, 667, 975
Liverpool and Great Western Steam Company.....			67, 667	957, 062		3, 492, 984
Anchor line.....			247	2, 2-5		
<b>Total</b> .....	<b>338, 012</b>	<b>2, 564, 091</b>	<b>461, 685</b>	<b>6, 438, 109</b>	<b>7, 197, 986</b>	<b>24, 617, 022</b>
Compared with last fiscal year. } Increase.....	23, 958	213, 354	171, 142	1, 389, 335	572, 442	7, 612, 649

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 15.—*Weight of letters and newspapers, &c., sent from the United States to Belgium during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
Hamburg-American Packet Company .....	173, 161	487, 156
North German Lloyd of Bremen .....	243, 354	915, 554
White Star line .....	52, 730	74, 965
Cunard line .....	921, 340	655, 730
Liverpool and Great Western Steam Company .....	115, 553	346, 752
Inman line .....	12, 072	24, 296
Anchor line .....	4, 035	16, 764
Red Star line .....	1, 049	.....
American Steamship Company .....	380	2, 122
<b>Total</b> .....	<b>823, 714</b>	<b>2, 541, 378</b>
Increase compared with last fiscal year .....	111, 569	134, 759

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 16.—*Weight of letters and newspapers, &c., sent from the United States to Switzerland, in closed mails, via England and Belgium, and by direct steamer, via Bremen and Hamburg, during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
North German Lloyd of Bremen .....	523, 134	2, 222, 227
Hamburg-American Packet Company .....	391, 785	1, 705, 732
Cunard line .....	437, 284	1, 030, 961
Liverpool and Great Western Steam Company .....	327, 114	1, 246, 542
White Star line .....	46, 265	241, 587
Inman line .....	16, 655	53, 001
Anchor line .....	9, 310	53, 454
American Steamship Company .....	1, 035	7, 072
<b>Total</b> .....	<b>1, 752, 586</b>	<b>7, 486, 462</b>
Increase compared with last fiscal year .....	470, 100	506, 010

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 17.—*Weight of letters and newspapers, &c., sent from the United States to the Netherlands during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
North German Lloyd of Bremen .....	441, 722	1, 685, 313
Cunard line .....	290, 764	498, 222
Hamburg-American Packet Company .....	243, 361	547, 261
Liverpool and Great Western Steam Company .....	214, 094	323, 967
White Star line .....	52, 280	126, 419
Inman line .....	11, 295	29, 445
Anchor line .....	6, 180	21, 291
Netherlands-American Steam Navigation Company .....	3, 250	821
American Steamship Company .....	380	1, 456
<b>Total</b> .....	<b>1, 963, 326</b>	<b>3, 945, 532</b>
Increase compared with last fiscal year .....	323, 294	1, 225, 207

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 12.—*Weight of letters and newspapers, &c., sent from the United States to Denmark during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
Hamburg-American Packet Company.....	779, 200	1, 417, 994
North-German Lloyd of Bremen .....	417, 529	802, 268
Anchor line.....	6, 290	22, 940
White Star line.....	7, 725	11, 109
Total .....	1, 210, 744	2, 254, 311
Increase compared with last fiscal year.....	66, 022	867, 282

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 19.—*Weight of letters and newspapers, &c., sent from the United States to Italy during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
North-German Lloyd of Bremen .....	593, 197	2, 060, 941
Conard line .....	506, 927	1, 488, 485
Hamburg-American Packet Company .....	370, 481	1, 298, 404
Liverpool and Great Western Steam Company.....	347, 350	899, 148
Isman line .....	18, 820	42, 129
White Star line .....	49, 220	189, 740
Anchor line .....	9, 095	42, 469
American Steamship Company.....	1, 220	4, 077
Total .....	1, 896, 310	6, 025, 393
Increase compared with last fiscal year.....	232, 033	715, 322

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST OFFICE DEPARTMENT, October 23, 1876.

No. 20.—*Weight of letters and newspapers, &c., sent from the United States to Sweden during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
Hamburg-American Packet Company.....	1, 548, 139	2, 216, 688
North German Lloyd of Bremen .....	865, 180	1, 262, 250
Anchor line .....	11, 000	27, 675
White Star line .....	12, 825	12, 394
Total .....	2, 437, 144	3, 519, 907
Increase compared with last fiscal year .....	345, 010	1, 052, 323

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 21.—*Weight of letters and newspapers, &c., sent from the United States to Norway during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
Hamburg-American Packet Company .....	1, 145, 519	2, 151, 836
White Star line.....	12, 120	11, 139
North-German Lloyd of Bremen .....	696, 271	716, 081
Anchor line.....	12, 090	11, 474
Total .....	1, 866, 000	2, 890, 530
Increase compared with last fiscal year .....	409, 514	1, 178, 243

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 22.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to Ecuador during the fiscal year ended June 30, 1876.*

Pacific Mail Steamship Company.	Letters.	Newspapers, &c.	Postages on letters.
Received.....	637	129	\$127 40
Sent.....	3, 074	5, 950	826 05
Total .....	3, 711	6, 079	953 45
Add newspaper postages, at two cents each.....			121 58
Total postages.....			1, 075 03
Decrease compared with last fiscal year.....	3, 124	2, 500	463 55

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 23.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to Venezuela during the fiscal year ended June 30, 1876.*

Pim, Forwood & Co.'s Line.	Letters.	Newspapers, &c.	Postages on letters.
Received.....	2, 340	1, 188	\$70 20
Sent.....	2, 083	2, 964	154 00
Total .....	4, 423	4, 152	224 20
Add newspaper postages, at two cents each.....			53 04
Total postages.....			307 24
Compared with last fiscal year.....	{ Increase .....		1, 190 .....
	{ Decrease .....		1, 519 .....
			140 54

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.



No. 24.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to New Granada during the fiscal year ended June 30, 1876.*

Pim, Forwood & Co.'s Line.	Letters.	Newspapers, &c.	Postages on letters.
Received .....	5,742	1,376	\$287 10
Sent .....	11,958	12,524	597 90
Total .....	17,700	13,900	885 00
Add newspaper postages, at two cents each .....			278 00
Total postages .....			1,163 00
Decrease compared with last fiscal year .....	2,173	387	1,118 18

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 25.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to Panama and Colon during the fiscal year ended June 30, 1876.*

Pacific Mail-Steamship Company, and other steamers.	Letters.	Newspapers, &c.	Postages on letters.
Received .....	113,244	64,686	\$8,573 30
Sent .....	96,055	167,307	10,917 46
Total .....	209,299	231,993	19,490 76
Add newspaper postages, at two cents each .....			4,639 86
Total postages .....			24,130 62
Decrease compared with last fiscal year .....	11,041	18,378	9,230 73

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 26.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to Mexico during the fiscal year ended June 30, 1876.*

United States and Mexican Steamship Company.	Letters.	Newspapers, &c.	Postages on letters.
Received .....	38,042	29,903	\$1,403 22
Sent .....	46,182	56,552	4,353 45
Total .....	84,224	86,455	5,756 67
Add newspaper postages, at two cents each .....			1,729 10
Total postages .....			7,485 77
Increase compared with last fiscal year .....	15,788	23,299	1,180 93

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 27.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to Brazil during the fiscal year ended June 30, 1876.*

	Letters.	Newspapers, &c.	Postages on letters.
Received .....	38, 448	50, 714	\$5, 033 58
Sent.....	38, 831	40, 047	6, 511 18
Total.....	77, 279	90, 761	11, 544 76
Add newspaper postages, at two cents each.....			1, 815 22
Total postages.....			12, 369 98
Decrease compared with last fiscal year.....	19, 703	5, 106	4, 014 86

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 28.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to the West India Islands during the fiscal year ended June 30, 1876.*

West India Mail-steamers.	Letters.	Newspapers, &c.	Postages on letters.
Received .....	523, 710	108, 091	\$22, 800 13
Sent.....	466, 555	229, 585	22, 293 31
Total.....	990, 265	337, 676	45, 093 44
Add newspaper postages, at two cents each.....			6, 753 52
Total postages.....			52, 446 96
Compared with last fiscal year.....	{ Increase..... 66, 473	{ 9, 076	{ 35, 121 63
	{ Decrease.....		

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 29.—*Statement of letters and newspapers, with the several postages, received in and sent from the United States to Japan and China during the fiscal year ended June 30, 1876.*

Pacific Mail Steamship Company.	Letters.	Newspapers, &c.	Postages on letters.
Received.....	159, 757	96, 857	\$2, 806 04
Sent.....	96, 717	164, 308	10, 650 02
Total.....	256, 474	261, 165	13, 456 06
Add newspaper postages, at two cents each.....			5, 223 30
Total postages.....			18, 679 36
Decrease compared with last fiscal year.....	11, 445	7, 060	7, 016 60

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.



No. 33.—*Statement of the postages collected in the United States on the letter-mails exchanged between the United States and Nova Scotia and Newfoundland during the fiscal year ended June 30, 1876.*

Amount on prepaid letters sent .....	\$2,089 61
Amount on unpaid letters received.....	36 99
Total amount.....	2,126 60

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 34.—*Weight of letters and newspapers, &c., sent from the United States to Spain during the fiscal year ended June 30, 1876.*

Lines.	Letters.	Newspapers, &c.
	<i>Grams.</i>	<i>Grams.</i>
North-German Lloyd of Bremen .....	82,965	397,269
Cunard line .....	76,390	379,862
Hamburg-American Packet Company.....	37,775	213,463
Liverpool and Great Western Steam Company.....	40,565	153,296
White Star line .....	13,595	73,554
Inman line .....	5,420	18,573
American Steamship Company .....	450	1,552
Total .....	257,180	1,239,577

NOTE.—Prior to January 1, 1876, the Spanish mail was sent in the French mail.

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 35.—*Weight of letters and newspapers, &c., sent from the United States to European countries during the fiscal year ended June 30, 1876.*

Countries.	Letters.	Newspapers.
	<i>Grams.</i>	<i>Grams.</i>
United Kingdom of Great Britain and Ireland .....	44,258,757	263,014,405
Germany .....	27,085,027	23,922,270
France .....	6,438,109	24,617,622
Belgium .....	823,714	2,541,574
Netherlands .....	1,263,326	3,245,532
Switzerland .....	1,752,586	7,426,462
Italy .....	1,896,310	6,025,393
Denmark .....	1,210,744	2,254,311
Sweden .....	2,437,144	3,519,007
Norway .....	1,866,000	2,890,530
Spain .....	257,180	1,239,577
Total .....	89,288,897	340,695,687
Compared with last fiscal year .....	<div> { Increase .....</div> <div> { Decrease .....</div>	23,088,012
	2,275,700	

J. M. MCGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 36.—*Number of letters exchanged between the United States and foreign countries, other than transatlantic mails, during the fiscal year ended June 30, 1876.*

Countries.	Number of letters.	
	Received.	Sent.
Panama .....	113, 244	96, 055
Mexico .....	38, 042	46, 182
Brazil .....	38, 448	38, 831
Ecuador .....	637	3, 074
Venezuela .....	2, 340	2, 083
New Granada .....	5, 742	11, 958
Guatemala and San Salvador .....	6, 815	9, 068
West India, &c. ....	573, 710	466, 555
China and Japan .....	159, 757	96, 717
Honolulu, Auckland, &c. ....	87, 762	85, 787
Bermuda .....	23, 514	15, 090
<b>Total</b> .....	<b>1, 050, 011</b>	<b>871, 340</b>
Increase compared with last fiscal year .....	21, 044	26, 046

J. M. McGREW, Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 37.—*Amounts reported as due the steamers of the Inman line for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$2, 926 72
Quarter ended December 31, 1875 .....	2, 784 51
Quarter ended March 31, 1876 .....	1, 027 08
Quarter ended June 30, 1876 .....	1, 510 97
<b>Total amount paid</b> .....	<b>8, 249 28</b>

*Amounts reported as due the steamers of the North-German Lloyd of Bremen for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$6, 510 23
Quarter ended December 31, 1875 .....	5, 959 46
Quarter ended March 31, 1876 .....	7, 102 76
Quarter ended June 30, 1876 .....	5, 759 75
<b>Total amount paid</b> .....	<b>25, 332 20</b>

*Amounts reported as due the steamers of the Canadian line for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$763 01
Quarter ended December 31, 1875 .....	780 76
Quarter ended March 31, 1876 .....	863 18
Quarter ended June 30, 1876 .....	801 07
<b>Total amount paid</b> .....	<b>3, 208 02</b>

*Amounts reported as due the steamers of the Hamburg American Packet Company for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$9, 449 94
Quarter ended December 31, 1875 .....	8, 775 98
Quarter ended March 31, 1876 .....	9, 036 88
Quarter ended June 30, 1876 .....	7, 200 66
<b>Total amount paid</b> .....	<b>34, 463 46</b>

*Amounts reported as due the steamers of the Cunard line for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$7,462 19
Quarter ended December 31, 1875 .....	9,664 90
Quarter ended March 31, 1876 .....	11,314 79
Quarter ended June 30, 1876 .....	10,463 21
Total amount paid .....	38,905 09

*Amounts reported as due the steamers of the Liverpool and Great Western Steam Company for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$6,821 43
Quarter ended December 31, 1875 .....	6,133 03
Quarter ended March 31, 1876 .....	4,896 07
Quarter ended June 30, 1876 .....	4,243 24
Total amount paid .....	22,093 81

*Amounts reported as due the steamers of the White Star line for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$2,712 74
Quarter ended December 31, 1875 .....	2,175 94
Quarter ended March 31, 1876 .....	5,455 56
Quarter ended June 30, 1876 .....	4,890 05
Total amount paid .....	15,234 29

*Amounts reported as due the steamers of the American Steamship Company for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$476 66
Quarter ended December 31, 1875 .....	433 73
Quarter ended March 31, 1876 .....	425 32
Quarter ended June 30, 1876 .....	632 96
Total amount paid .....	1,968 67

*Amounts reported as due the steamers of the Anchor line for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$484 70
Quarter ended December 31, 1875 .....	1,105 74
Quarter ended March 31, 1876 .....	267 42
Quarter ended June 30, 1876 .....	109 32
Total amount paid .....	1,967 18

*The sea-postages on the mails conveyed from the United States to France by the steamers of the French Steamship Company, and settled in the accounts between the United States and France, during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$418 06
Quarter ended December 31, 1875 .....	605 92
Quarter ended March 31, 1876 .....	375 77
Quarter ended June 30, 1876 .....	677 15
Total amount paid .....	2,076 90

*Amounts reported as due the steamers of the Netherlands Steam Navigation Company during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$1 65
Quarter ended December 31, 1875 .....	1 11
Quarter ended March 31, 1876 .....	
Quarter ended June 30, 1876 .....	
Total amount paid .....	2 76

*Amounts reported as due the steamers of the Pacific Mail Steamship Company for the conveyance of the mails between the United States and Panama during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$4,535 16
Quarter ended December 31, 1875 .....	4,335 48
Quarter ended March 31, 1876 .....	4,101 53
Quarter ended June 30, 1876 .....	3,061 59
<b>Total amount paid .....</b>	<b>16,033 76</b>

*Amounts reported as due the steamers conveying the mails between the United States and the West India Islands, Mexico, Brazil, New Granada, Bermuda, and New Zealand for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$5,607 63
Quarter ended December 31, 1875 .....	6,161 77
Quarter ended March 31, 1876 .....	9,667 69
Quarter ended June 30, 1876 .....	7,053 79
<b>Total amount paid .....</b>	<b>28,490 88</b>

*Amounts reported as due the steamers conveying the mails between the United States and Nova Scotia for services rendered during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$256 37
Quarter ended December 31, 1875 .....	293 03
Quarter ended March 31, 1876 .....	236 20
Quarter ended June 30, 1876 .....	125 55
<b>Total amount paid .....</b>	<b>911 15</b>

The following reports for the transportation of closed mails for the periods named have been made during the fiscal year ended June 30, 1876.

To the steamers of the Liverpool and Great Western Steam Company :

Quarter ended March 31, 1875 .....	\$1,393 28
Quarter ended June 30, 1875 .....	109 52
<b>Total .....</b>	<b>1,502 80</b>

To the steamers of the Cunard line :

Quarter ended December 31, 1874 .....	428 35
Quarter ended March 31, 1875 .....	478 27
Quarter ended June 30, 1875 .....	2,046 90
<b>Total .....</b>	<b>2,953 52</b>

To the steamers of the White Star line :

Quarter ended March 31, 1875 .....	53 25
Quarter ended June 30, 1875 .....	1 17
<b>Total .....</b>	<b>54 42</b>

To the steamers of the Hamburg-American Packet Company :

Quarter ended December 31, 1874 .....	229 17
Quarter ended March 31, 1875 .....	162 38
Quarter ended June 30, 1875 .....	125 65
<b>Total .....</b>	<b>517 20</b>

To the steamers of the North-German Lloyd line :

Quarter ended December 31, 1874 .....	465 02
Quarter ended March 31, 1875 .....	27 56
Quarter ended June 30, 1875 .....	7 30
<b>Total .....</b>	<b>499 88</b>

## To the steamers of the Eagle Hamburg line:

Quarter ended December 31, 1874.....	\$1,692 53
Quarter ended March 31, 1875 .....	2,567 56
Quarter ended June 30, 1875.....	1,149 42
<b>Total .....</b>	<b>5,409 57</b>

## To the steamers of the Inman line:

Quarter ended December 31, 1874.....	2 56
Quarter ended March 31, 1875 .....	1 84
Quarter ended June 30, 1875.....	1,310 55
<b>Total .....</b>	<b>1,314 99</b>

## To the steamers of the Dominion line:

Quarter ended March 31, 1875 .....	63 98
<b>Total .....</b>	<b>63 98</b>

J. M. MCGREW,  
Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

No. 38.—*Balances due the United States on the adjustment of the postal accounts between the United States and Switzerland for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875 .....	\$1,900 69
Quarter ended September 30, 1875.....	21 11
Quarter ended December 31, 1875.....	24 73
<b>Total .....</b>	<b>1,946 53</b>

*Balances due the United States on the adjustment of the postal accounts between the United States and the Netherlands for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875 .....	\$1,170 12
Quarter ended September 30, 1875.....	12 74
Quarter ended December 31, 1875.....	14 00
<b>Total .....</b>	<b>1,196 86</b>

*Balances due the United States on the adjustment of the postal accounts between the United States and Italy for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875.....	\$1,405 74
Quarter ended September 30, 1875.....	16 26
Quarter ended December 31, 1875.....	19 36
<b>Total .....</b>	<b>1,441 36</b>

*Balances due the United States on the adjustment of the postal accounts between the United States and France for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875.....	\$4,538 03
Quarter ended September 30, 1875.....	4,776 10
Quarter ended December 31, 1875 .....	3,993 24
<b>Total.....</b>	<b>13,307 37</b>



*Balances due the United States on the adjustment of the postal accounts between the United States and the empire of Germany for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875.....	\$451 49
Total .....	451 49

*Balances due the United States on the adjustment of the postal accounts between the United States and Belgium for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875.....	\$57 58
Total .....	57 58

*Balances due the United States on the adjustment of the postal accounts between the United States and Sweden for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875.....	\$10 36
Quarter ended December 31, 1875.....	12 15
Total .....	22 51

*Balances due the United States on the adjustment of the postal accounts between the United States and Norway for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875 .....	\$119 34
Quarter ended December 31, 1875.....	12 17
Total .....	131 51

*Balances due the United States on the adjustment of the postal accounts between the United States and Spain for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended September 30, 1875.....	\$1 91
Total .....	1 91

*Balances due from the United States to the empire of Germany on the adjustment of the postal accounts between the United States and Germany for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875.....	\$12, 224 91
Total .....	12, 224 91

*Balances due from the United States to the United Kingdom of Great Britain and Ireland on the adjustment of the postal accounts between the United States and the United Kingdom for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended March 31, 1875.....	\$5, 860 64
Quarter ended June 30, 1875.....	3, 520 18
Total.....	9, 380 82

*Balances due from the United States to the kingdom of Denmark on the adjustment of the postal accounts between the United States and Denmark for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875.....	\$212 63
Total .....	212 63

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*Balances due from the United States to the kingdom of Belgium on the adjustment of the postal accounts between the United States and Belgium for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875.....	\$2,011 6
Quarter ended December 31, 1875.....	3,827 6
Total .....	5,839 2

*Balances due from the United States to the kingdom of Sweden on the adjustment of the postal accounts between the United States and Sweden for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended June 30, 1875.....	\$3,457 46
Total .....	3,457 46

*Balances due from the United States to the kingdom of Norway on the adjustment of the postal accounts between the United States and Norway for the quarters indicated; settlements made during the fiscal year ended June 30, 1876.*

Quarter ended March 31, 1875.....	\$1,464 29
Quarter ended June 30, 1875.....	1,025 04
Total .....	2,489 33

J. M. MCGREW  
Auditor.

OFFICE OF THE AUDITOR OF THE TREASURY  
FOR THE POST-OFFICE DEPARTMENT, October 23, 1876.

# REPORT

OF THE

# SECRETARY OF THE NAVY;

BEING PART OF

## THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

## TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE SECOND SESSION OF THE FORTY-FOURTH CONGRESS.

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WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1876.



# CONTENTS.

## REPORT OF THE SECRETARY OF THE NAVY.

	Page.
Naval force .....	3
Condition of the vessels .....	4
Marine ram recommended .....	6
Repairs on monitors .....	7
Cruising-stations .....	8
Personnel of the enlisted men .....	11
Naval education .....	12
Astronomical observations .....	13
Nautical Almanac .....	15
Surveys for interoceanic canal .....	15
Determination of geographical positions .....	16
Deep-sea exploration .....	17
Arctic expedition .....	17
Hydrography .....	17
Hydrographic Office .....	19
Ordnance .....	20
Navy-yards .....	21
Centennial Exhibition .....	22
Coaling-station, Saint Mary's River .....	22
Navy pension-fund .....	23
Estimates and expenditures .....	23
Conclusion .....	26

## SUPPLEMENT.

Expenditure of Navy appropriations .....	27
Character and condition of the Navy, 1869-1876 .....	27
General operations of the fleets, &c .....	34

## APPENDIX.

No. 1. Estimates, Secretary's Office .....	41
2. Naval Academy .....	42
Report of superintendent .....	42
Estimates of appropriations .....	44
Report of board of visitors .....	47
Address to the graduating class .....	49
Cruise of practice-ship Constellation .....	54
Cruise of practice-ship Mayflower .....	55
3. Bureau of Yards and Docks .....	58
4. Bureau of Navigation, with reports of Naval Observatory, Hydrographic Office, &c .....	89
5. Bureau of Equipment and Recruiting .....	103
6. Bureau of Ordnance .....	110
7. Bureau of Medicine and Surgery .....	232
8. Bureau of Provisions and Clothing .....	247
9. Bureau of Steam-Engineering .....	249
10. Bureau of Construction and Repair .....	278
11. Marine Corps .....	282
12. Report of Prof. E. S. Holden on astronomical instruments .....	289
13. Report of Rear-Admiral T. A. Jenkins, Centennial Exhibition .....	324
14. Detailed movements of vessels .....	327



# REPORT OF THE SECRETARY OF THE NAVY.

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NAVY DEPARTMENT,  
*Washington, D. C., November 29, 1876.*

SIR : The following report of the Navy Department and naval service for the present year is respectfully submitted.

## NAVAL FORCE.

There are now belonging to the Navy of the United States 146 vessels of 150,157 tons measurement. Exclusive of howitzers and Gatlings they carry 1,142 guns. Of these, 123, carrying 913 guns, with a measurement of 120,894 tons, have steam-power, and 23, carrying, nominally, 229 guns, with a measurement of 29,263 tons, are sailing-vessels.

The steam-vessels are rated as follows :

	Guns.	Tons.
5 first-rates .....	188	15,163
29 second-rates .....	478	53,800
30 third-rates .....	164	19,506
6 fourth-rates .....	4	3,143
27 tugs .....	6	4,729
2 torpedo-boats .....	1	749
24 iron-clads .....	72	23,804
<hr/> 123	<hr/> 913	<hr/> 120,894

The sailing-vessels are rated as follows :

	Guns.	Tons.
4 second-rates .....	36	10,700
15 third-rates .....	188	15,919
4 fourth-rates .....	5	2,644
<hr/> 23	<hr/> 229	<hr/> 29,263

The iron clad vessels are rated as follows :

	Guns.	Tons.
6 second-rates .....	28	12,261
4 third-rates .....	16	4,275
14 fourth-rates .....	28	7,268
<hr/> 24	<hr/> 72	<hr/> 23,804

All the tugs are regarded as fourth-rates.

Of the whole number of vessels, 75 are at present in actual use, as

follows: 37 are in commission attached to fleets, in which number are embraced 11 iron-clad vessels on the North Atlantic station; 2 are in use as training-ships; 6, on special service and as dispatch and freight ships; 2 are torpedo-boats; 5 are receiving-ships; 2 are store-ships; 2 more are used by States, under act of Congress, as school-ships; and 19 are in use as quarters, gunnery-ships, tenders, &c., at the navy-yards and shore-stations. Of the remainder, 4 are preparing and almost ready for sea; 8 are under repairs; and 59 are laid up at the various navy-yards.

The actual condition of the material of the naval service at this time, and what has been done with it during your administration, may perhaps be better understood by comparing it with itself as it existed in 1869. This may be done fully by referring to the particular statement of the character, service, repairs, and condition of each ship, which will be found appended to this report, and a general idea may be obtained from the following summary, which contains some of the results of the fuller statement referred to.

The number of vessels belonging to the Navy in 1869, including screw and side-wheel steamers, tugs, iron-armored vessels, and sailing-ships, was, as follows:

Iron-clads.....	52
Screw-steamers.....	67
Side-wheel steamers, large and small.....	23
Tugs and small side-wheel steamers, not fitted for fighting.....	32
Sailing-vessels, store, surveying, and receiving ships.....	29

Whole number.....	203
-------------------	-----

Of these there were unavailable for fighting purposes the following, viz:

Vessels on the stocks built of live-oak.....	1
Vessels on the stocks built of white oak.....	5
Tugs used for yard purposes.....	32
Sailing-vessels used as practice, store, and receiving vessels, but of no use for fighting purposes.....	29
Iron-clads on the stocks built of white oak, and unfit for use by reason of decay.....	4
Iron-clads not of sufficient displacement, and entirely unfit for war purposes..	21

In all.....	92
-------------	----

To which should be added the Niagara, Puritan, and Susquehanna, which were without machinery, and in such condition that as much time and money would be required to put them in sea-going order as to build new vessels. They were consequently unavailable .....

Total .....	95
-------------	----

Which deducted from the 203 vessels, as above, leaves as the available force of the Navy at that time .....

Of the 108 available vessels, as above, 47 were being completed or repaired, or were laid up at the several navy-yards; and of these, 21 screw-steamers and 4 iron-clads were built of white oak, and had all begun



to decay. Their usefulness was therefore of short duration, as their history, found in the appendix to this report, shows. The other iron-clads, which possessed the proper fighting qualities, and are included in the 108 vessels, were also more or less rotten, and all required extensive repairs. Of the 203 vessels of 1869, there have been sold 46; broken up, 18; lost at sea, 5—69 vessels; thus reducing the number to 134 vessels. To which add the addition made to the Navy since 1869, of new vessels, 10; purchased vessels, 2; making the whole number on the register at the present time 146 vessels. For a full and particular understanding of the character and condition of these vessels, reference may be had to the appendix already mentioned. This will show that of our present force of 146 vessels, of every class, 40 are built of iron viz, 5 double-turreted iron-clads, 15 single-turreted monitors, 2 torpedo-boats, and 18 steamers of various classes. Of the remainder, 65 are of live-oak, viz, 1 iron clad, 5 steamers of the first rate, 20 steamers of the second rate, 19 steamers of the third rate, and 20 sailing-vessels. The remaining 41 are white-oak ships, of almost every class. Of the whole number, 75 are, as has been before stated, in actual service, and 4 are preparing for sea; 16 may be considered as entirely used up and unfit for future service; and the balance are at the various navy-yards, some requiring slight and others extensive repairs; but most of them could be made ready for any special service in a short time. Seventeen of our steamers have been furnished with compound engines and boilers of the best class, and with the latest improvements, and nearly all our other steamers have, during the last eight years, been supplied with new boilers, and their machinery extensively repaired.

There is also on hand, stored at the various navy-yards, live-oak timber sufficient for 35 new ships of war, besides a large quantity of other valuable timber and naval material of every kind.

This statement shows that after eight years of active service of every kind, during which period it has suffered the loss of four ships by actual disaster, and seen many others of its valuable cruisers come to final decay and utter worthlessness, by reason of hasty construction from perishable material, during time of war, our Navy is now, in the character and condition of its ships and material, in a condition far superior to that in which it was in 1869, and indeed far more powerful for our warlike purposes than it has ever before been in time of peace. It does not compare, either in number or character of vessels, with the expensive establishments of those European nations whose mutual relations keep them always in armed array, whose contiguous coasts and deep harbors at home, and scattered colonies all over the world, seem to require that they should constantly rival each other, at whatever expense, in the size and power of their naval vessels and armaments; but, for the defensive purposes of a peaceful people, without colonies, with a dangerous coast, and shallow harbors, separated by a vast ocean from warlike naval powers, our Navy is not without strength, and when its iron-clad

fleet shall be completely repaired, a work requiring now but little time and expense, and its force supplemented by the comparatively cheap addition herein recommended, it will, I think, be found sufficient to resist any force which could be brought across the ocean to attack us; and powerful also for offensive operations upon the seas and among the islands which lie contiguous to our own shores. In view of the fact that the appropriations for the two principal working bureaus of the Department average but little over five millions annually, and considering the cost of merely maintaining a Navy, consisting largely of ships hurriedly built of perishable material, which after requiring for a few years constant repair finally drop out of the service from utter worthlessness, I think that this state of things reflects great credit upon those officers through whose practical knowledge and ability the Department has been able to utilize all that there was valuable in the Navy, and to bring it to its present state of efficiency.

The question of what should compose a sound and economical, but efficient, naval force has presented during the past few years so many different aspects that we may perhaps congratulate ourselves that we have not followed step by step in the practical but expensive development of the problem in which other maritime nations have been engaged. The question constantly recurs, however, brought up by conflicting interests and opinions, shall we enter upon the expensive and unsatisfactory construction of armor-plated gun-bearing vessels, involving millions of dollars in the cost of each one? or shall we be content with providing ourselves, at a minimum cost, with the means of destroying such vessels should they appear in hostile attitude on our coasts or in our bays or harbors? Fast, well-built wooden cruisers, proper for the police of the seas, serving as schools of instruction in time of peace and capable of destroying an enemy's commerce in time of war, are under all conditions serviceable. The monitor class of vessels has, for us, special and valuable uses in conjunction with other forces. The torpedo-schools give our officers the instruction necessary to utilize whatever there is in this most efficient arm of attack and defense; and I would add to the force a new element, the marine ram, which promises, when constructed upon scientific principles, in forms of special strength for its particular and appropriate service, to be a weapon of most destructive warfare. The construction of this class of vessels has been carefully considered for several years past by a naval officer of high rank, assisted by able experts, and detailed plans are put at the service of the Department without cost or charge of any kind. The construction of such a vessel of the best material and of special strength would involve an expense of about \$350,000, and if successful, as it promises to be, it would add a new element tending to make our force complete in itself, at once economical and efficient.

With such a force and with no colonies to defend, I think we may well dispense, for the present at least, with the heavy-armored and unwieldy

iron-clads of European nations, and, also, with the monster cannon necessary to penetrate them. Any vessel which can safely cross the seas to enter our harbors or to lie upon our shores will be found vulnerable to cannon of moderate weight and caliber, while the heaviest armor will not protect a ship from the attacks of torpedoes managed by brave and well-instructed officers. Thus, our monitor system, supported by the marine ram, commanded by enterprising officers, and re-enforced by the deadly torpedo in skillful and scientific hands, will, I think, supply all that is absolutely necessary for the naval share of our coast-defense, and will be found efficient, for our purposes, against any foreign iron-clads which can reach our coasts or enter our harbors. With these we may rest content for the present, but it must be understood that the Navy, in all its efficient elements, is in a constant state of transition and progression, and can only be kept efficient by seizing, experimenting upon, and developing, in the quiet times of peace, each new principle of warlike progress as it arises.

Of the amount of appropriations asked for the next year, as herein-after stated, I beg to suggest that the sum of \$1,550,000 of the amount estimated for the Bureau of Construction and Repair and \$750,000 of that estimated for the Bureau of Steam-Engineering, be made available at once, in order that the repairs of our five double-turreted iron-clads, which have been for some time regularly progressing out of the current annual appropriations, may be completed. These have been delayed in the hands of the contractors during the current year by the fact that the appropriations made for these bureaus were not sufficient for their continuance. The reasons why this should be done at once are many, and will be readily understood. The vessels are, as I have said, in the hands of the contractors, actually in a state of partial repair. These repairs, to be economically and properly done, should progress regularly, as a continuous work, with the different parts advancing simultaneously, of homogeneous material, on a concurrent plan, under the same general direction, and, as far as possible, with the same workmen. To stop it from time to time must involve more or less of change in all these conditions, to the manifest increase of the cost and injury to the quality of the work. Delay involves, also, increased cost of superintendence, care-taking, and preservation, and risk of injury or loss to the public property. The work can be done now cheaper than at any other time, and if done now it will give employment, at a season of great distress, for establishments and workmen to whom it is not only kindness but practical wisdom on the part of the Government to afford all proper encouragement and assistance. Besides, the ships are useless to the Government while in progress of repair, but when concluded, they will constitute a large element of the strength of our Navy, and, adding immensely to its fighting power, will raise it to a position more in harmony with our national responsibility and requirements.

There is no additional money asked for this purpose, but only that a

portion of the regular appropriations be made available for it now. The amount asked is the same which was estimated for this work last year, but which was not then appropriated; and by taking it from the amount estimated for the next year, without enlarging that estimate, the Department will be able to go on with this necessary work, to the great advantage of the Government, without increasing the appropriations, and the work being done, the bureaus can be carried on with the amounts estimated for them reduced by the amount which this work costs.

#### CRUISING-STATIONS.

These are the same as were reported last year, including within the limits assigned to them every important field of naval operations. The strength of the force on each station is as follows :

*European station.*—Rear-Admiral John L. Worden commands the naval force on the European station, which is now much reduced. The Franklin, Congress, Juniata, and Alaska have returned home during the present year, and the squadron has been re-enforced only by the Marion and the Vandalia.

In pursuance of orders of the Department the Congress and Juniata left Villefranche November 29, 1875, for Port Royal, to join the force on the North Atlantic station.

The Alaska left Lisbon January 1, for the coast of Africa, under special instructions from the Department, the revolt of the native tribes against the republic of Liberia being then in progress and seriously threatening the safety of the colonists. Capt. A. A. Semmes, commanding the Alaska, was ordered to confer with the minister of the United States at Monrovia and the President of Liberia, to protect American citizens and interests; to manifest the friendly disposition of the people of the United States and Government toward the citizens of the government of Liberia; to cruise along the coast, show the flag to the natives, and act in conjunction with the Liberian authorities in suppressing the revolt among the natives. She arrived at Monrovia, February 3. The President of Liberia, with his suite, was received on board.

The Franklin, after proceeding under special orders to Vigo, Spain, left that port for home on the 28th of September. Delayed by adverse winds and calms, her voyage was long, and she only reached New York on the 23d of the present month.

The present aspect of European affairs makes it proper that this squadron should be strengthened as promptly as possible, and the Department contemplates re-enforcing it with the Trenton as soon as she can be fitted out, and in the mean time with such other ships as can be spared from their present duty.

*Asiatic station.*—The force on this station is the same as stated in the last annual report of the Department, with a single change. It was reduced in May by the Saco, ordered to San Francisco, and again in-

creased by the arrival in August of the *Alert*, from New York, via the Suez Canal. Rear-Admiral William Reynolds remains in command.

The following-named vessels now compose his force: The *Tennessee*, (flag-ship,) *Kearsarge*, *Ashuelot*, *Alert*, *Monocacy*, and *Palos*—all with steam-power, and carrying altogether forty-eight guns.

Owing to the great distance of this station from our Atlantic ports, it has been found to be to the interest of the Government to repair some of the vessels out there rather than to send them home for that purpose. This has been done during the past year, and some which have been on the station for two or three times the usual time have been provided with new boilers and otherwise repaired, so as to make them useful cruisers for some time to come.

*North Pacific station.*—The *Pensacola*, (flag-ship,) and the *Lackawanna*, are the only vessels now in commission on this station, which is under the command of Rear-Admiral Alexander Murray, who relieved Rear-Admiral John J. Almy, July 1.

The *Tuscarora* and *Portsmouth*, which have been attached to this station during the year, were put out of commission at Mare Island—the former in September and the latter in August.

*South Pacific station.*—The vessels on this station at the date of the last annual report of the Department were the *Richmond*, (flag-ship,) *Omaha*, and stationary store-ship *Onward* at Callao, and Rear-Admiral Reed Werden was then in command.

Rear-Admiral Werden was relieved July 13 by Commodore C. H. B. Caldwell, who went out on the mail-steamer from New York June 23.

On the 12th of August Commodore Caldwell sailed from Callao, in the *Richmond*, for Montevideo, touched at Valparaiso, and was heard from at Sandy Point, Straits of Magellan, early in October. He is no doubt now on the coast of Brazil, and, in pursuance of the Department's orders, in command of the naval force on the South Atlantic station.

On the departure of Commodore Caldwell, Capt. Edward Simpson, commanding the *Omaha*, was left the senior officer present on this station, but Rear-Admiral Murray arrived recently at Panama and is now in command in those waters.

*The South Atlantic station.*—The force on this station, which consisted of the *Brooklyn*, (flag-ship,) *Monongahela*, and *Wasp*, and was under command of Rear-Admiral William E. Le Roy, was reduced last December by the withdrawal of the *Brooklyn* and *Monongahela* for service on our own coast and the departure of Rear-Admiral Le Roy in his flag-ship for Key West.

The station has since been re-enforced by the arrival of the *Richmond* from the South Pacific station, and the command devolves, under the orders of the Department, upon Commodore C. H. B. Caldwell. The *Frolic* is the only other vessel on the station, the *Wasp* having been sold.

*The North Atlantic station.*—The force on this station, which consisted one year ago of nine cruisers and six other vessels, and was under the command of Rear-Admiral J. R. M. Mullany, was soon afterward largely increased by attaching to it vessels from the European and the South Atlantic station, and putting in commission some of the new sloops and ten of the monitors. By these accessions it consisted in February, when Rear-Admiral Mullany was relieved by Rear-Admiral William E. Le Roy, of twenty-four vessels, not including store-ships and tugs, viz: Hartford, (flag-ship,) Brooklyn, Congress, Plymouth, Ossipee, Vandalia, Marion, Monongahela, Swatara, Shawmut, Alert, Huron, Dictator, Wyandotte, Passaic, Catskill, Nantucket, Lehigh, Montauk, Canonicus, Ajax, Saugus, Mahopac, and Manhattan. In addition, there were in commission two torpedo-boats, the Alarm and the Intrepid, also four other steamers, the Powhatan, Juniata, Tallapoosa, and Dispatch, all within the limits of the station, which, although not strictly part of Rear-Admiral Le Roy's command, were available for immediate service; thus making at hand thirty-one vessels, twelve of which were monitors and two powerful torpedo-boats. This force was maintained as long as there seemed to be any possibility of its use. Some of the cruising-vessels were then sent to other stations, others were put out of commission, and nearly all the monitors, although kept in commission, were reduced in their complements, with only a sufficient number of officers and men retained on board to keep the vessels in good condition.

The force on this station by recent additions now consists of the Hartford, Plymouth, Swatara, Adams, Essex, Ossipee, Huron, Ranger, all the monitors above named except the Nantucket, and the store-ship New Hampshire, hospital-ship Pawnee, and tug Sea-Weed stationed at Port Royal, S. C.

The Powhatan, Despatch, Tallapoosa, Monongahela, Rio Bravo, Alarm, and Intrepid are also in commission and ready for service, but not strictly a part of the squadron.

The general operations of our cruisers on the several stations will be found in brief in the supplement hereto annexed, entitled "General operations of fleets," and more at large in the statement and reports published in the appendix, and which will be found interesting to those desiring information on this subject.

The Department has lately adopted the plan of retaining all ships, on going into commission, upon this coast and attached to the North Atlantic squadron for a few months previous to ordering them abroad. It is believed that the effect has been beneficial, as any defects in the ships or their machinery can then be remedied at home, and the discipline of the *personnel* can be perfected in our own waters. With this preliminary drill and inspection the ships reach foreign stations in an efficient and creditable condition.

The Department has also commissioned as receiving-ships at the different naval stations the frigates Wabash and Colorado at Boston and

New York, and proposes to place the Franklin at Norfolk, instead of the hulks formerly used for this purpose. These ships, with those used for training and school ships, form a reserve, maintained without additional expense, and ready to be used in any emergency.

The reduction of the force of our fleet, by act of Congress, from 8,500 to 7,500 men has placed our Navy, in the *personnel* of the enlisted men, below that of nearly every navy of Europe. The effect of this reduction has been to lose to the service many valuable seamen, who, for want of continuous employment in the Navy and in the absence of any commerce of our own, have been forced to go abroad for employment. Their services are thus lost to the country, and the time and care given to their education as men-of-war's men has been to some extent in vain. As a remedy for this misfortune, and for the purpose of maintaining a trained class of men in the Navy, skilled in their duties and devoted to their flag, I have the honor to repeat my recommendations of last year, that Congress give the necessary authority to enlist annually 750 boys for the Navy, under existing laws, but in addition to the number of men now allowed. The cost of these boys, so far as the pay of the Navy is concerned, would not amount to more than the cost of 250 men ; and it is expected that this number enlisted annually will, in the course of a few years, not only fill the vacancies made by discharge, death, and desertion, but finally man our fleet with educated American seamen.

The system of training boys has been in successful operation for little more than one year, and there are at present 479 in the service, one-half of them under instruction on board the training-ships Minnesota and Monongahela, and the others already afloat in various sea-going vessels. The Department has stationed the Minnesota at New York, the Constitution at Philadelphia, and the Monongahela at Baltimore, as permanent school-ships for these lads, and the experience of the past year fully demonstrates the success of this effort to improve our seamen. I feel myself, therefore, most fully justified in earnestly renewing my recommendation of this addition to the *personnel* of the Navy.

I would also call your attention to other recommendations contained in the report of the Chief of the Bureau of Equipment and Recruiting, intended to benefit the seaman of the Navy. Among them is the urgent and often-repeated recommendation that the enlisted men of the Navy may be allowed an outfit of clothing. This allowance has, for several years, been considered both by the Department and by the Navy at large as eminently proper and just, and has, on several occasions, been urged in Congress, but as yet it has failed to receive that attention which I think it deserves. I trust, however, that sooner or later a law will be passed granting an outfit of clothing to the enlisted men, under such restrictions and regulations as the Department may establish.

The report of the Chief of the Bureau of Equipment and Recruiting contains another request which I deem worthy of consideration. He urges the establishment of a banking system for the Navy, similar to

that now in force in the Army, where it has produced the most satisfactory results. The Army law authorizes the payment of interest at 4 per cent. upon all sums of \$50 and upward deposited by any enlisted man with the paymasters, subject to certain conditions and restrictions. If this system should be adopted for the Navy, a careful estimate of the sum that would be required for the payment of the interest places it at but \$24,000 per annum. The men of the Navy are rarely paid off before the expiration of their three years' term of service, and the money, which is actually their own, is thus left in the United States Treasury, without any benefit accruing to the rightful owners. It is no more than proper and just that a moderate interest should be granted by the Government for its use. I am convinced that the foregoing suggestions, if put into effect as laws, will prove of great and lasting benefit to our Navy, without adding materially to the cost of its maintenance, and I therefore respectfully refer them to the favorable consideration of Congress.

#### NAVAL EDUCATION.

*The Academy.*—The worth of an educational institution must be judged by the adaptability of the course of studies pursued to the profession for which its students are destined, and by the thoroughness with which these are taught.

The Naval Academy, under its able Superintendents, has been conducted with these objects in view, and the basis of an education afforded by this institution is such as is demanded for Navy officers of the present day.

In the past, in the days when canvas was the motive-power, the battery smooth-bore guns, and gunnery in a crude state, a general knowledge of seamanship, navigation, and gunnery was deemed sufficient for the ordinary education of a Navy officer. A few years has changed this, and the Naval Academy has kept pace with these changes as they have occurred.

Recent improvements in naval warfare are largely indebted to the sciences. A built-up gun, a torpedo, an iron gun-carriage, the armor on a ship's side, the newly-improved engines, the powerful gunpowders, dynamite, and other explosives, the use of the electric telegraph in longitudes, the understanding of the machines now in use for testing the velocity and strength of powder, and many other changes which the last few years have brought forth, are based upon and permeated by some principle of physics, chemistry, electricity, mechanics, and mathematics; so that at the present day an officer, to be familiar with the weapons he is called to wield, must be acquainted with the sciences upon whose principles these weapons are constructed. These are taught at the Naval Academy. Ships will not again be fought under sail, and the tactics of Paul Hoste, so valuable in their day, must give way to those of recent date.

As the motive-power, in action, is hardly of less importance than the



battery itself, it behooves a commanding officer to have an intelligent idea of the construction, working, and proper use of the engines and boilers of the vessel he commands; hence the instruction in both theoretical and practical steam-engineering. It must not be understood, however, that steam and its applications are taught to the exclusion of seamanship. On the contrary, this branch, with the addition of ship-building, is taught with every minuteness of detail, requiring but the constant practice afloat, in after life, to give the quick perception, the prompt decision, and instant action so requisite and so remarkably pertaining to the thorough seaman under all circumstances. Now, as heretofore, the first requisites of a Navy officer must be seamanship, navigation, and gunnery, however closely these may be crowded by other acquirements indispensably necessary.

As I have before said, the system of the Naval Academy has kept pace with the changes which have taken place, and the branches there taught are those adapted to the naval profession of to-day. With such a basis of education, the officers who have had the advantages of this institution should excel in every branch of their profession.

*The naval signal-service.*—The system of signals in the Navy has undergone great improvement within the past few years, more attention having been given to this most important subject than heretofore. A new and complete signal-book has been issued, bearing the impress of the talent and intelligence of its compilers and of the labor and care bestowed upon it.

Experiments have been made with various descriptions of lights for signaling on shipboard; with many patterns of side-lights and running lights, to prevent collisions at sea; as also with systems of fog-signals, and flash and sound telegraphy. A careful supervision has been exercised over the signal departments of vessels in commission.

*The torpedo station.*—The branches taught at the Naval Academy are immediately brought into practice at the torpedo station, which has been furnished, as far as practicable, with every appliance for making and experimenting with this formidable weapon of modern warfare. A class of such officers as can be spared from the other duties of the service are instructed at the torpedo station during several months of each year in all relating to the torpedo. All gain a practical knowledge of its manipulation; some, taking a special interest in this branch, pursue it to invention. Though this school of instruction has necessarily been conducted on a limited scale, it has grown in importance and has been marked by improvement from year to year.

#### ASTRONOMICAL OBSERVATIONS.

During my term of office the duties of the Naval Observatory have been diligently and faithfully performed, under the able superintendence of Rear-Admirals B. F. Sands and C. H. Davis. The quiet and unobtrusive manner in which the work of this institution is carried on, pre-

vents the general public, perhaps, from appreciating its value, and few people know how diligently and constantly the tasks devolving on astronomers are prosecuted.

Provided by wise liberality with the best instruments obtainable, the Naval Observatory has risen to a high rank, both at home and abroad, for efficiency and for the character of the work accomplished, and has amply fulfilled the expectations of its founders. As is eminently pertinent, the work of general scientific research has not been prosecuted, but the more appropriate routine for a government observatory, of making such daily and nightly observations of sun, stars, and planets as may afford information useful to the navigator and surveyor, has been constantly carried on.

In addition to the regular routine-work of the observatory, expeditions for the observation of the solar eclipse of December 22, 1870, and for the transit of Venus on December 8, 1874, were organized and sent out, in both cases with most gratifying success. The highest commendations of the eclipse observations were received from astronomers at home and abroad, and the work of reducing the transit of Venus observations has progressed sufficiently to prove that the labor and expense attendant on the expedition was well bestowed. The work at the desolate stations, intrusted to Navy officers, was well and satisfactorily performed, affording another proof, if such were needed, that the groundwork of education received at the Naval Academy produces most satisfactory results. The several parties, composed of civilians, military and Navy officers, co-operated with the most gratifying harmony. All the parties and instruments dispatched to different parts of the world have been safely returned, and it is satisfactory that our countrymen, by care and skill, were successful in the safe return of their instruments, as, from several places, in this the astronomers of other nations failed.

Besides the yearly volume of observations and results, there has been published by the Observatory many other contributions to astronomical science, among the most important of which are:

A report on the solar eclipse of 1869.

A report on the position of fundamental stars, by Professor Newcomb.

A report on the position of 151 stars in Præsepe, by Professor Hall.

A report of the solar eclipse of 1870.

A report of the right ascensions of equatorial fundamental stars, by Professor Newcomb.

A catalogue of 10,658 stars, by Professor Yarnall, depending on upwards of 100,000 observations.

An investigation of the Uranian and Neptunian systems with the 26-inch equatorial, by Professor Newcomb.

The Observatory has also co-operated in the determinations of longitude, by the telegraphic method, of Havana, Saint Louis, Detroit, Carlin, (Nev.,) Austin, (Nev.,) Ogden, Bethlehem, (Pa.,) and Key West.

Electric clocks, controlled by the clock at the Observatory, have been established at the Navy, Treasury, and State Departments, and at the Signal-Office, and it would appear desirable that this system should be extended to all the Departments and to the Chambers of the Senate and the House of Representatives. The time is furnished daily to the Western Union Telegraph Company, and is by them distributed over the country for the benefit of railroads, commerce, and the public generally. An extension of this system seems desirable.

The chronometers belonging to the Navy are as heretofore kept at the Observatory, and their errors carefully ascertained before sending them on board of vessels.

Upon the opening of the South Kensington Exhibition of Scientific Instruments, at London, in June last, Prof. E. S. Holden, U. S. N., was temporarily detached from duty at the Observatory and directed to examine and report on the exhibition. This was thoroughly and promptly accomplished, and a most interesting and valuable report was submitted by him to the Department.

#### THE NAUTICAL ALMANAC.

The preparation and issue of the American Ephemeris and Nautical Almanac, under the able and scientific superintendence of Prof. J. H. C. Coffin, U. S. N., has reflected credit on the country and on the Navy, and supplies that which would otherwise necessarily be drawn from abroad.

It is issued to the vessels of the Navy, to our commerce, to the various exploring and surveying expeditions of the Army, to the United States Coast Survey, the Land-Office, the various observatories and astronomers, and to colleges and other institutions, especially to those in which astronomical observations or investigations are conducted. From year to year its tedious and monotonous work of calculation goes steadily on, with such additions as new discoveries require.

#### SURVEYS FOR INTEROCEANIC CANAL.

During the last eight years the Navy have been also employed in various explorations and surveys in Central America and on the isthmus of Panama, with a view to ascertain the best locality for a ship-canal to connect the Atlantic and Pacific Oceans. We have made—

1st. A sufficient and conclusive examination and survey of the isthmus of Tehuantepec.

2d. An instrumental survey locating a canal-route from the vicinity of Greytown via Lake Nicaragua, the Rio del Medio, and Rio Grande to Brito, on the Pacific coast. In this vicinity a careful examination was made of other routes besides the one chosen in order to select the best. These surveys extended over two seasons, and estimates for the entire cost of labor and materials have been submitted.

3d. A survey for a canal from the harbor of Aspinwall to Panama along the line of the railway, with approximate estimates of cost.

4th. Two attempts, one from either coast, for locating a canal-route between the Chepo River and the Gulf of San Blas, which clearly indicated the impracticability of this route.

5th. Attempts were made in the vicinity of Caledonia Bay to find a route for a canal, but even with a tunnel through the mountains this route was at once seen to be impracticable.

6th. Examinations were made of a route by way of the Tuyra River and the valley of the Atrato, which dispose effectively of the pretensions of Señor Gorgoza and others. It was found that the elevation of the Pacific water-shed, when reached, would make a canal here simply impossible.

7th. An instrumental survey was made, (involving several tentative lines,) and a route located by way of the Uraba River, the mouth of the river Atrato, and by way of the Napipi River to the Pacific. Plans and estimates have been submitted for this route, which involves the construction of a tunnel as well as conduits for water-supply. This work extended over three seasons.

The Department has to regret that no appropriations were made for the publications of this important survey, nor for that of the Isthmus of Panama, equally important in the settlement of the question of the best location for an interoceanic canal.

Although this work does not, strictly speaking, come within the scope of the ordinary duties of naval officers, it has been performed with great zeal, skill, and self-devotion, several of the officers employed having seriously injured their health by protracted exposure in a sickly climate.

#### DETERMINATION OF GEOGRAPHICAL POSITIONS IN THE WEST INDIES AND CENTRAL AMERICA.

Under the United States Hydrographic Office and the bureau of Navigation, without any extra appropriation, a commencement has been most successfully made of the task of accurately determining points to which future surveys may be referred. The increased accuracy of both instruments and methods makes the errors existing in geographical positions, and especially in their longitudes, no longer tolerable, and in 1874, 1875, and 1876 the work of determining exactly the latitudes and longitudes of eleven stations in the West Indies and Central America was carried out with great success. This work has met with the cordial appreciation of men of science both of our own country and abroad. As the methods and instruments used are those especially employed in this country, it is eminently fit that the work so successfully begun and of such acknowledged importance should be continued along the coast of South America. The instruments, outfit, and staff of officers are ready, with the advantages of experience in the field, and the work can be carried on by a naval vessel without any extra appropriation.

## DEEP-SEA EXPLORATION.

Much has also been accomplished in the direction of deep-sea exploration. In two successive cruises of the United States steamer *Tuscarora*, with a view of laying telegraphic cables in the Pacific, lines of sounding were made first between California, the Sandwich Islands, and Japan, under the command of Commander G. E. Belknap, and between the Sandwich Islands and Australia, under command of Commander J. N. Miller. During the first cruise no less than 483 soundings were made, and on the second, 107 were taken, serial temperatures being observed and bottom-specimens obtained.

This work was admirably done and reflects great credit on the officers employed in it. Deep-sea soundings between Saint Thomas, West Indies, and Cape Henry, by way of Bermuda, have also been made by the United States steamer *Gettysburg*.

## THE ARCTIC EXPEDITION.

The Arctic expedition in the *Polaris* was also conducted under the direction of the Navy Department; its history is too generally known to require further mention.

## HYDROGRAPHY.

The United States Hydrographic Office, established by act of Congress in 1866, was but little more than a depot of purchased charts and books for the use of the Navy until 1870, from which time its steady advancement may be dated. With but a small force of draughtsmen and engravers, the greater portion of the work has devolved on officers of the Navy. It has been the endeavor of the Navy Department to foster and increase this office, so important to our commercial and naval marine, and to place it as quickly as possible on a footing with similar offices abroad. In the short interval since the establishment of this office, the work, as directed by law, of preparing sailing-direction and charts for the use of navigators, has been diligently carried on, the office having constructed, compiled, and issued since 1870 twenty-five distinct volumes of sailing-directions and 437 charts. Many of its publications are now viewed as standard works, and its charts have acquired reputation for their correctness and for the information which they contain. The yearly sales of charts and books to its agents in the ports of the United States have averaged 1,020 books for the purposes of navigation and 5,030 charts, besides those issued to naval vessels and exchanges with foreign governments for their latest publications. A system of exchanges of hydrographic information with the hydrographic offices of all maritime nations has been so perfected that, at the earliest possible moment after the appearance in any part of the world, and in any language, of information which may be useful in aiding the navigator to safely conduct the ship under his charge to its destination, it is pub-

lished and circulated wherever it may be of service. In this work the hydrographic offices of Great Britain, France, Germany, Austria, Spain, Portugal, Italy, Holland, Denmark, Belgium, Sweden, Russia, Brazil, and Chili unite with our own. Since 1870, 449 hydrographic notices of changes or new discoveries in the earth's surface have been issued, as also 682 notices to mariners of alterations in artificial aids to navigation, such as light-houses and buoys, together with yearly-corrected lists of foreign lights. This work is done by Navy officers and requires the translation and careful examination of a mass of material brought by every mail.

It has been the object and endeavor of the Department to employ naval vessels as far as their duties would permit in surveys and in such explorations as might be beneficial to navigation and to science. To a certain extent it has been enabled to accomplish this without any additional appropriation. Extensive surveys, however, cannot be conducted without a small special appropriation.

The surveys performed under the auspices of the Hydrographic Office, though fewer in number than would have been made with the requested appropriations, have been important. The survey of the coasts of Lower California by the United States steamer *Narragansett* afforded the first accurate delineation of these coasts, rapidly growing in commercial importance; the preliminary charts published two years since by this office were at once copied and republished by both German and English authorities. With the exception of the small appropriation for commencing this survey, none other has been granted, excepting for the ordinary work of the office. By the cruise of the United States steamer *Portsmouth*, the list of doubtful dangers in the Pacific Ocean was somewhat reduced and valuable surveys were made of Washington, Christmas, Palmyra, and Fanning Islands. In the West Indies several rocks and shoals marked on the charts as doubtful were, by the assiduous searches made by the United States ships *Kansas*, *Shawmut*, *Nipsic*, *Vandalia*, &c., proved to have no existence, and others heretofore considered as doubtful were located and distinctly established.

The coast of Mexico from the Rio Grande to Laguna de Terminos has also been surveyed by the United States ships *Wyoming* and *Fortune*. In this survey, in addition to clearly laying down the coast-line and adjacent shoals, the approaches to the coast were carefully sounded out as far off shore as the 100-fathom line.

A very good, though not extensive, survey of the approaches to Montevideo has been made by the officers of the United States ship *Wasp*, and, by the officers of the United States ship *Pensacola*, surveys of harbors in the island of Hawaii. Occasional surveys have been made in the Pacific Ocean by the officers of the United States ships *Ossipee*, *Jamestown*, *Richmond*, and *Omaha*; in the East Indies by those of the United States ships *Ashuelot* and *Iroquois*; in the West Indies by the United States ship *Canandaigua*, and within the Rio de la Plata by the United States ship *Frolic*.

The International Exhibition of 1875, at Santiago, Chili, awarded a first-class medal and diploma to the Hydrographic Office for the excellence of its publications, as also one to the hydrographer under whose superintendence these publications were issued.

#### HYDROGRAPHIC OFFICE.

Having called your attention to the creditable and satisfactory progress of the United States Hydrographic Office, to the ability and diligence of those connected with it, and to the amount of valuable practical work there accomplished within the term of my administration of the Navy Department, I must express the regret of the Department that even the very limited estimates for this work have been cut down; that no appropriation has been given for the continuance of the survey in the Pacific Ocean; and that this important office, with its valuable collection of charts, books, and plates, is still under the necessity of occupying a rented building, unsafe and inadequate to its requirements. Owing to the reduction of the appropriation for printing, this office is unable to issue some of its works necessary for commerce, and many of the charts of the coasts and gulf of Lower California, from the surveys made by the United States ship *Narragansett*, are as yet not engraved for want of the required appropriation. To these matters, so important to our maritime interests, I would especially ask the attention of Congress. During the past fiscal year the work under the Hydrographic Office for the determination of longitudes through the West India Islands by the electric telegraph, by Lieut. Comdr. F. M. Green, United States Navy, in the United States ship *Gettysburgh*, has been completed; the stations of Key West, Havana, Santiago de Cuba, Kingston, (Jamaica,) Aspinwall, Panama, San Juan, (Porto Rico,) Saint Thomas, Santa Cruz, Saint Pierre, (Martinique,) Bridgetown, (Barbados,) and Port Spain (Trinidad) were occupied, the measurements of longitudes being made from Key West, the position of which had been previously carefully determined by the United States Coast Survey. The most accurate methods known were used in determining these positions, the latitudes being fixed by the zenith telescope and the longitudes by the exchange of time-signals through the submarine-telegraph cables.

The success of this work has fully justified the expectations formed of it. For the first time the latitudes and longitudes of these islands, so much visited by vessels of all nations, and especially by those of the United States, have been fixed so decidedly as not to admit of question. The most gratifying cordiality and assistance were extended to the officers engaged in this work, both by foreign authorities and by the officials of the telegraph companies. The observations are now being computed as rapidly as possible, and will be published as soon as completed. As the service will permit, vessels of the North Atlantic

squadron will be employed to carry the longitude chronometrically to the points intermediate between the several established stations.

The United States ship *Gettysburg* is at present employed in obtaining the required information for Parts II and III of the Description of the Coasts and Islands of the Mediterranean, and in making and correcting surveys where necessary. For a statement of the work of this office since my last report, I refer you to the report of the hydrographer to the chief of the Bureau of Navigation.

#### ORDNANCE.

When the war closed, the armament of the Navy was in a very confused and unsatisfactory state. The necessity of fitting out hurriedly irregular vessels had pressed into service all the obsolete armament on hand, while the war itself had developed the absolute necessity of efficient rifle armaments for any navy which was hereafter to contend on equal terms with the ships of hostile powers. Under these circumstances, notwithstanding the requirements of a rigorous economy in this expensive branch, and the desire to utilize the means on hand, which was proper and required after the drain of a great war, I have endeavored, as far as possible, to lay the foundation of a general system of progress in our ordnance, and to carry it as far forward as possible in its most pressing and least expensive particulars. During my term of office there has been introduced a uniform system of breech-loading small-arms, a supply of Gatling guns, with the carriages and equipment adapted to their use ashore and afloat.

A system of breech-loading howitzers has also been devised, and is now issued to the service. An entire rifle armament of 8-inch guns, with suitable mechanical carriages, has been placed on board the *Trenton*, the first in our Navy. Successful experiments have been made for the conversion of our supply of Parrott rifles into breech-loaders, as the only means of arming our small vessels, of little beam, with guns efficient in modern naval warfare; and many other experiments have been made in this direction, which have demonstrated the possibility of most favorable results, if properly pursued.

The torpedo-school has been, under the able officers and professors charged with its direction, a most valuable school for practice and instruction in what I believe to be a most useful and inexpensive adjunct to our means of offensive and defensive warfare, and destined to play a great part in all future naval wars.

The subject of gunpowder has also received much attention, and successful experiments have been made to determine the necessary elements of its best manufacture, to the end that we may have it of uniform and safe quality. Most of the accidents which befell our rifled cannon were due to the unsuitable powder which, under the pressure of war, we were forced to procure from all sources, without time for the experimental tests necessary to determine the quality proper for these guns, then newly introduced.



## NAVY-YARDS.

I beg to renew the recommendations made in my successive annual reports in reference to our navy-yards and stations, and to urge that their resources may be increased, and that sufficient appropriations may be made to keep them in thorough repair, and ready for any emergency which may arise.

The sum of \$760,000 for maintenance and \$500,000 for repairs and preservation of all the navy-yards and stations was appropriated for the fiscal year ending June 30, 1876. This amount was carefully allotted to the different yards and stations according to their relative importance and necessities, and has been judiciously expended.

At the Boston, New York, Norfolk, and Pensacola navy-yards little has been accomplished beyond keeping the docks, workshops, and piers in a fair state of repair.

During the spring and summer of the present fiscal year, thorough repairs should be made at the navy-yards named ; but the appropriation is so inadequate for the amount of work necessary to be done, that only minor reparations can be attended to, and, consequently, largely increased appropriations will be indispensable for the fiscal year ending June 30, 1878.

*New London, Conn.*—At the naval station, New London, there has been expended during the last fiscal year, for maintenance of station, for grading the site, for completing store-house, repairs to wharf, and for the erection of stables, blacksmith-shop, and watch-house, the sum of \$55,717.07.

*League Island, Pa.*—By authority of an act of Congress, the old navy-yard at Philadelphia was sold at public auction on the 2d day of December, 1875. Prior to the sale, arrangements had been made for the removal of all material, stores, and other public property from the navy-yard to League Island. Temporary wooden buildings had been provided for the reception of the stores, and the Philadelphia navy-yard was delivered to the purchaser upon the day specified in the terms of sale.

Since the removal of the Philadelphia navy-yard to League Island much work has been done in deepening the back channel and filling-in, building foundations, the superstructures of which will be partially, and in some instances wholly, erected from old material removed from the Philadelphia navy-yard ; and there are now in process of construction, under contract, extension of main wharf, foot of Broad street ; causeway across back channel ; storage and mold loft ; extension of wharf No. 2 ; and completion of steam-engineering building ; and by Bureau of Yards and Docks, temporary machine-shop for Bureau of Steam-Engineering ; temporary blacksmith-shop for Bureau of Construction and Repair ; foundations for officers' quarters nearly finished, and the buildings themselves will be commenced in the spring.

At Mare Island the buildings have been kept in repair, and the

appropriation for the stone dry-dock has been advantageously expended. The sum appropriated for the fiscal year ending June 30, 1877, for the continuance of the work upon the dry-dock, is merely sufficient to prevent deterioration of work already accomplished, to keep in repair the coffer-dam, and to have a small reserve in hand in case of any unforeseen accident.

The report of the board of five commissioned officers, ordered by Congress "to examine fully and determine whether any of the navy-yards can be dispensed with," &c., will be forwarded when received.

I beg to call attention to the estimates of the Bureau of Yards and Docks, and to say that in consequence of the insufficient appropriations of the past few years the sums asked for, although largely in excess of the appropriation for the last and present fiscal years, are indeed less than true economy and the needs of the service demand.

#### CENTENNIAL EXHIBITION.

The naval exhibits at the United States Centennial Exhibition, which opened May 10 and closed November 10, were under charge of Rear-Admiral Thornton A. Jenkins, assisted by some other officers of the Navy, detailed in connection with the different bureaus represented there. For a better understanding of the extent of the exhibit I refer you to the synopsis of the classes of articles displayed, which will be found in the appendix, and to the following extracts from Rear-Admiral Jenkins's report to the Department:

Without presuming to pass judgment upon the professional or popular estimates as mere exhibits of the articles and objects arranged in the naval section of the Government building, I may be permitted to say that the opinions of all classes of persons, so far as I have heard, have been most favorable, and greatly to the credit of the Naval Department and naval service of the country.

On the 5th of May (five days in advance of the formal opening of the Exhibition) the exhibits in the naval section were arranged and in the main labeled in English, French, and German, showing sections, classes, numbers, names, and description of each object. A catalogue, embracing every object on exhibition, was prepared and widely distributed among the different foreign commissioners and the representatives of the different States and Territories of the United States.

A few weeks prior to the close of the Exhibition, the very unique and highly-interesting exhibits presented by His Majesty the King of Siam to the United States through Rear-Admiral Reynolds, (commanding the Asiatic station,) and the Navy Department, were received at the Government building, and within a week these curious, wonder-inspiring articles were all arranged in cases and on tables, all properly labeled, and a catalogue made out.

I trust I may be permitted to say, in conclusion, that, whatever may have been the misgivings as to probable success, in the outset of the undertaking, the naval exhibit at the International Centennial Exhibit of 1876 has been most creditable to the Navy.

#### COALING-STATION, SAINT MARY'S RIVER, MARYLAND.

On the 13th of April, 1874, the House of Representatives passed a resolution directing me to appoint a board of naval officers to inquire

as to the expediency of establishing, at the harbor of the Saint Mary's River, Maryland, a naval coaling-station. On the 14th of January, 1875, I submitted to the House of Representatives the report of said board of naval officers for the consideration and action of Congress. I now have the honor to call, through you, the attention of Congress to the same subject for such action as they may think fit. If the coaling-station is to be established, an appropriation of \$10,000 will be needed.

## NAVY PENSION-FUND.

The following is a statement of the number and yearly amount of pensions of the Navy on the rolls June 30, 1876, and the amount which was paid during that fiscal year :

	On roll June 30, 1876.	Annual amount of roll.	Amount paid for pensions during fiscal year ended June 30, 1876.
Navy invalids.....	1, 643	\$183, 716	\$187, 132 72
Navy widows and others.....	1, 744	287, 726	309, 338 39
<b>Total .....</b>	<b>3, 387</b>	<b>471, 442</b>	<b>496, 471 11</b>

## ESTIMATES AND EXPENDITURES.

On the 1st of July, 1875, the amount of the appropriations applicable to the fiscal year ending June 30, 1876, was \$18,301,731.27. The actual expenditure of these appropriations during that period, namely, from July 1, 1875, to June 30, 1876, was \$17,937,354.72, or about \$364,376.55 less than the whole amount.

The appropriations available for the present year, commencing July 1, 1876, are, in the aggregate, \$12,961,790.90. The whole amount of these appropriations drawn, up to the 1st of the current month, was \$7,879,757.19. From this may be deducted the amount in the hands of the paymasters and agents of the Government and the amounts refunded during the period above mentioned, which will reduce the amount of these appropriations actually expended since the commencement of this fiscal year, and during the working-months, to less than \$7,000,000. A statement of the monthly expenditure of these appropriations since July 1, 1875, is hereto annexed and will make part of this report. The estimates for the general maintenance of the Navy for the next year are as follows :

*Estimates.*

Pay of officers and seamen of the Navy.....	\$7, 300, 000 00
Pay of civil establishment in navy-yards.....	205, 922 00
Ordnance and Torpedo Corps .....	445, 575 00
Coal, hemp, and equipments.....	1, 250, 000 00
Navigation and navigation supplies .....	135, 136 44
Hydrographic work.....	89, 800 00

Naval Observatory, Nautical Almanac, &c.....	\$54,200 00
Repairs and preservation of vessels, &c.....	3,300,000 00
Steam-machinery, tools, &c.....	2,000,000 00
Provisions and clothing .....	1,403,721 85
Repairs of hospitals and laboratories.....	40,000 00
Surgeons' necessaries.....	40,000 00
Contingent expenses of various departments and bureaus.....	351,000 00
Naval Academy .....	199,262 40
Support of Marine Corps.....	905,769 00
Naval Asylum, Philadelphia .....	63,597 00
Maintenance of yards and docks .....	862,029 00
	<hr/>
	12,646,012 69

The amount estimated for new buildings and the repairs and improvements necessary at the various navy-yards, stations, and hospitals is \$2,908,596.

There is also submitted by the Bureau of Ordnance an estimate for the sum of \$775,500, deemed necessary to provide the proper armament for our large iron-clads and other ships now being fitted for sea. This shows an aggregate sum of about \$300,000 less than the amount which was asked for last year for like purposes.

How small these appropriations of less than \$13,000,000 really are for the carrying on of our naval service at this time will be seen by comparing them with the naval appropriations made in 1856, (\$15,701,968.49;) in 1857, (\$14,125,434.55;) in 1858, (\$13,109,359.36,) and in 1859, (\$15,987,079.49,) a period when the Navy consisted of only about 50 sailing-vessels, with a dozen side-wheel steamers, and about the same number of screw-vessels, against the 23 sailing-ships and 123 steamers now on the register; when our motive-power was the free wind of heaven, and our ships were not supplied with expensive steam-machinery of great weight, occupying great space on shipboard, and required neither the large supply of fuel, appliances, and material necessary to the use of this machinery, nor the numerous body of officers and men employed to prepare, operate, and preserve it; when armored ships were unknown, and the armaments of our most powerful cruisers consisted principally of 32 and 64-pounders, against 200-pound rifles and 15-inch guns of these times; when the materials and supplies for naval use were comparatively cheap; when skilled labor was not half its present price, and its working-hours had not been reduced by one-fifth; and when the pay-roll of the Navy had not assumed half its present proportions, and contained but few invalids and no reserve-list.

But however small the appropriations may be, it is nevertheless the duty of the Department to reduce the expenses of the service upon the same scale, as far as it can be done within the provisions of existing laws. This it has endeavored to do, though it is not often economical nor always possible, to confine the expenses of a military establishment within fixed and unyielding limits. This is especially the case with the naval service, scattered all over the globe, often at the mercy of the natural elements, and always liable to international conditions, which

neither the Department nor the Government can foresee; for which they are not responsible, and which they can neither direct nor control. In endeavoring to adapt itself to this necessity, the Department has been crippled in carrying on much important work which was already in progress, and which is rendered more expensive by this delay; and it has also been constrained to put in force upon the service generally the provisions of law which authorized it to place officers on "furlough-pay." The power of Congress to limit the appropriations for "pay" to the requirements of this provision of existing law, and the power and duty of the Department, when so limited, to put the provision in force, will hardly be questioned by any one who can bring to the consideration of the subject an unbiased legal judgment.

That the intent of Congress was so to limit the appropriations is unquestionable, in view of their statements, debates, and actions at the time, and of the fact that they were fully informed, that the appropriations made upon this principle would impose upon the Department the duty of carrying out the spirit of their legislation, as far as it could be done under the law as it stood on the statute-book, rather than to make a deficiency by disregarding their action and its intent. The "pay" provided by these provisions, however, was not adapted to the circumstances and necessities of the present times, and they had grown obsolete in practice, except for the purpose of punishment; and whatever was their original intent, they cannot now be enforced upon the service as a whole without great inconvenience and privation to officers and their families, entailing, in many instances, personal hardship which, in the case of the deserving, amounts almost to absolute injustice.

You are fully aware how disagreeable this duty was to the Department; but you understood, also, how it had no alternative but to discharge it. Burdensome as its effect has been to the naval service, I am gratified to be able to say that it has been received by the officers generally with dignity and courage. There has been some fault-finding and some foolish criticism; but the fault-finding, as far as I am informed, has been confined to those who have been least affected, and who, in the present as in the past, have the least cause to complain of the favor of the Government or the action of the Department. Those who are charged with the burdens of official duty must expect always to meet the criticism of that class, who, without consideration or responsibility themselves, are ever ready to question the motives and actions of others.

After careful consideration of this subject, being convinced that Congress, when they fully understand it, will have no real desire to withhold from any branch of the service the pay which would accrue to it under the ordinary operations of the laws and customs governing the action of the Department, and will not wish to deprive well-deserving officers, whose lives are consecrated to their country's service, and to whom no personal fault is imputed, of the means for the proper support and education of their families, I have, besides the ordinary

estimates for the next fiscal year, submitted an additional one for the sum of \$1,550,000, to supply the inevitable deficiency in the "pay" appropriation, and to enable the Department to rescind its order placing all unemployed officers on "furlough-pay," and to make up to those who have been or may be so reduced, without fault on their part, the amount of pay which they would otherwise have received. Congress will be earnestly pressed to make this provision, and if they do so, the Department will have great gratification in carrying it out; otherwise the service and the Department will have no alternative but to submit to the deficiency and the reduction which it entails.

In conclusion, I take this last opportunity to again express my sense of the many and heavy obligations which I am under to the experienced officers and clerks employed in the Department and elsewhere in its service, and to the officers of the Navy as a class, for their constant assistance in the discharge of the many difficult and responsible duties which have devolved upon me during my term of office. If anything of good has been accomplished, it is to them that the country is largely indebted.

GEO. M. ROBESON,  
*Secretary of the Navy.*

The PRESIDENT.

## SUPPLEMENT.

*Exhibit of expenditure chargeable to Navy appropriations.*

Date.	Drawn.	Refunded.	Expended.
<i>Appropriations for 1875-'76.</i>			
1875.			
July .....	\$3,064,503 07	\$3 76	\$3,064,499 31
August .....	2,889,458 45	11,000 00	2,878,458 45
September .....	2,242,056 25	14,166 54	2,227,899 71
October .....	2,724,643 59	482,943 47	2,241,700 12
November .....	2,812,384 78	45,324 87	2,767,049 91
December .....	1,728,392 68	714,413 68	1,013,979 00
1876.			
January .....	1,178,999 43	523,956 42	655,043 01
February .....	1,570,730 39	555,918 46	1,014,811 93
March .....	968,096 39	214,516 10	753,580 29
April .....	763,154 00	114,254 31	648,899 69
May .....	749,399 02	525,437 59	223,961 43
June .....	680,738 92	223,257 05	447,481 87
Total .....	21,372,556 97	3,435,902 25	17,937,354 72
<i>Appropriations for 1876-'77.</i>			
1876.			
July .....	2,438,048 84	3,260 50	2,434,788 34
August .....	1,661,681 14	20,425 43	1,641,255 71
September .....	2,304,514 52	25,128 75	2,279,385 77
October .....	1,475,512 69	111,789 26	1,363,723 43
Total .....	7,879,737 19	160,603 94	7,719,133 25

1876.		
August 31. Appropriation-warrant No. 290, 1877 .....	\$12,688,817 90	
Appropriation-warrant No. 291, 1877 .....	220,000 00	
Naval Asylum, Philadelphia, Pa., 1877 .....	52,973 00	
		12,961,790 90

## STATEMENT OF CHARACTER AND CONDITION OF NAVY VESSELS 1869 TO 1876.

**NIAGARA.**—Auxiliary steam-power. In 1870 commenced repairs with a view to making this vessel an efficient war-vessel, by changing the line of gun and berth decks, iron-plating her sides near the water-line, and making new boilers and machinery. It was ascertained, however, that the cost of these alterations and repairs would be over one million dollars, and that a new vessel could be built for less money which would be in all respects superior to her when completed. Her repairs were, therefore, stopped, and she remains in ordinary.

**CONNECTICUT.**—Built of white oak, but never launched. At present she is somewhat rotten, but could be made serviceable for a year's cruise in six months, although at great cost.

**WA.**—White-oak vessel. Was tested as to speed and found very fast. She is now quite rotten, and will have to be repaired before going to sea.

**JAVA.**—Built of white oak, and in same condition as Connecticut.

**NEW YORK.**—Frame of live-oak; of good design and in good preservation.

**PENNSYLVANIA.**—Built of white oak, and in same condition as the Connecticut.

**SUSQUEHANNA.**—Repairs commenced with a view to changing her from a side-wheel to a screw ship, but the cost, after taking off rotten wood, was estimated to be above the amount required for the building of a vessel of a superior power and of modern design; consequently the repairs were stopped and the vessel was placed in ordinary.

**COLORADO.**—Auxiliary steam-power. In 1869 in ordinary. In 1871-'72, flag-ship on Asiatic station. In 1873-'74, laid up. In 1875, flag-ship on North Atlantic station. In 1876, school and practice ship. Requires repairs, but is in good condition for one year's service.

**FRANKLIN.**—Auxiliary steam-power. In 1871, '72, and '73, flag-ship on European station. In 1874-'75, laid up. In 1876, flag-ship on European station. Has been repaired several times since 1869.

**MINNESOTA.**—Auxiliary steam-power. In 1870, 1871, 1872, 1873, 1874, and 1875, repairing. In 1876, put in commission as practice-ship. Repairs have been very costly.

**WABASH.**—Auxiliary steam-power. In 1871, extensively repaired. In 1872, put in commission as flag-ship on European station. In 1874-'75, laid up. In 1876, practice-ship. Has been extensively repaired at great cost since 1869.

**FLORIDA.**—Live-oak ship. Has been tested and found to be very fast. Has done no service since, and will have to be repaired before going to sea.

**TENNESSEE.**—Live-oak frame. In 1869, was found to need repairs, and that her steam-power could be much improved. The repairs, which were found to be very expensive, were made and machinery improved. In 1875, was sent to sea as flag-ship on the Asiatic station, and has proved to be a very superior vessel.

**ANTIETAM.**—In 1869, on the stocks, and about two-thirds finished. Previous to moving the navy-yard to League Island, she was offered for sale at auction, but the price offered was considered inadequate, and she was calked, launched, and fitted for equipment store-ship. Is built of white oak, and her timbers are a little rotten. Can be used as a store-ship, but is not considered worth putting engines in.

**DELAWARE.**—In 1869-'70, was flag-ship on Asiatic station, and upon returning to the United States, in 1870, was found to be very rotten, and the estimated cost of repairs to her was considered above the cost of building a new and superior vessel. She has been offered for sale at auction, but the sum offered was considered inadequate, and she remains in ordinary.

**LANCASTER.**—Auxiliary steam-power. Was repaired in 1869-'70, and during the latter year was sent to the South Atlantic, remaining on that duty until the present year, when she returned to the United States. Upon her arrival the usual survey was made, when the cost of repairs, as estimated, was nearly a million of dollars. A new vessel, of modern design, could be built for less money.

**BROOKLYN.**—Auxiliary steam-power. In 1869, was laid up. Repaired in 1870. Was at sea during 1871 and 1872; returned in 1873. Repaired and sent to sea, North Atlantic fleet, 1874. In 1875, was in the South Atlantic fleet, returning in 1876. Was put in ordinary, and requires repairs.

**PENSACOLA.**—Auxiliary steam-power. In 1869, was flag-ship of North



Pacific squadron. Was repaired in 1870 and 1871, at a cost of over one million dollars, and has since that time been flag-ship in South and North Pacific squadrons.

**HAETFOED.**—Auxiliary steam-power. In 1869, was laid up, and in 1870-'71-'72 was extensively repaired. Since that time has been flag-ship of Asiatic and North Atlantic squadrons.

**RICHMOND.**—Auxiliary steam-power. In 1869, was fitting out and was put in commission in 1870. Has been in commission ever since that time, although at times under repair.

**CONGRESS.**—Built of white oak. In 1869 laid up. Was put in commission in 1870, and joined the North Atlantic squadron. Was on special service in 1872, and in 1873, '74, and '75 was in European squadron. Returned in 1876. Has been put out of commission and surveyed. Cost of repairs is considered too large for a white-oak vessel of her value when completed; consequently will be sold or broken up.

**SEVERN.**—White-oak built vessel. In 1869, laid up. In 1870 and 1871, was flag-ship of North Atlantic fleet, and since that time has not been in service. Upon survey she was found to be very rotten and unfit for repair. She has been offered for sale at auction, but the price bid was considered inadequate.

**WORCESTER.**—Built of white oak. In ordinary in 1869. Was completed in 1871, and was flag-ship of North Atlantic fleet in 1872, '73, '74, and '75. Is now used as a receiving-ship. Is considered too rotten for repair.

**POWHATAN.**—Live-oak. In 1869, was flag-ship of South Pacific squadron. Laid up in 1870 and in 1871-'72. Put in commission in 1872 on special service, and has been so employed up to the present time.

**ALASKA.**—Live-oak. Completed in 1869. Was put in commission in 1870, and joined Asiatic squadron. In 1873, was repaired and joined the European station, returning for repairs 1876.

**BENICIA.**—Built of live-oak. Completed in 1869, and joined the Asiatic fleet in 1870. Remained on that station until 1873, when she was employed in the North Pacific fleet until 1875, and then put out of commission for repair.

**OMAHA.**—Built of live-oak. Completed in 1872 and joined the South Pacific squadron the same year. Has been employed in that squadron until the present time.

**PLYMOUTH.**—Built of live-oak. Repaired in 1869. Joined European fleet in 1871. Returned in 1873 and was laid up for repair. Repaired in 1874, and has been up to the present time employed in North Atlantic fleet.

**LACKAWANNA.**—Built of live-oak. In 1869, was employed in North Pacific fleet. Repaired in 1870, '71, and '72, and in 1873, '74, and '75 was in the Asiatic squadron. In 1876, joined the North Pacific fleet.

**TICONDEROGA.**—Live-oak built. In 1869, was in the European squadron, and was very extensively repaired in 1870 and '71. Joined the South Atlantic fleet in 1872 and the North Atlantic fleet in 1874. Returned in 1875, and has since then been laid up for repair.

**MONONGAHELA.**—Live-oak built. In 1869 was in ordinary. Was repaired at very great cost and joined the South Atlantic fleet in 1874. Returned and put in commission as practice-vessel in 1876.

**SHENANDOAH.**—Live-oak built. Returned from a cruise in 1869. Was thoroughly repaired in 1870 and joined the European fleet. Remained on that station until 1874, when she was laid up for repair.

**JUNIATA.**—Live-oak ship. Repairing in 1869. Joined European fleet in 1871, remaining on that duty until 1873, when she was ordered to look

for the *Polaris*. Sent to the European fleet in 1874. Returned in 1876, and was laid up for repair.

**OSSIPEE.**—Live-oak ship. In North Pacific squadron in 1869, '70, '71, and '72. Employed in that and on South Pacific station. Repaired in 1873 and 1874. Joined the North Atlantic station, where she remains at the present time.

**QUINNEBAUG.**—White-oak ship. In South Atlantic squadron 1869 and '70, and in 1871 her repairs were commenced. The repairs were found to be so extensive and costly that it was deemed to be to the interest of the Government to change the white-oak frame for live-oak, and thus increase her capacity and speed. This was done, and although the repairs have not been fully completed, she can be made ready for sea in a short time.

**SWATARA.**—White-oak ship. In European squadron in 1869, repaired in 1870, and in North Atlantic fleet. Extensive repairs were found to be required, and in 1872 they were commenced. The needed repairs were found to be very extensive, and it was considered to be to the interest of the Government that her frame should be made of live-oak timber instead of white oak, insuring greater durability. It became necessary in carrying out this idea to increase her capacity, which was done sufficiently to increase her speed and fighting-power. She was completed and sent on special service with the expedition to witness the transit of Venus in 1874, and since that time has been attached to the North Atlantic fleet. The highest expectations of her good qualities have been realized, and she has proved to be one of the best vessels of her class in the Navy.

**GALENA.**—Repairs commenced in 1870; was found in the same condition as the *Swatara*, and the same changes were made. Her repairs are not yet completed, but she could be made ready for sea in three months.

**VANDALIA.**—Sailing-ship. Was receiving-ship in 1869 to 1871. Was converted into a steamship of the *Swatara* class, and put in commission in 1875. The reports speak of her excellent qualities as a working and fighting vessel.

**MARION.**—Was practice sailing-ship at Naval Academy in 1869, 1870, and 1871. Was converted into a screw-steamship of the *Swatara* class, and put in commission in 1875, and has proved to be an excellent man-of-war.

**IROQUOIS.**—Live-oak built. In Asiatic squadron 1869 and 1870. Repaired in 1871. Joined the Asiatic squadron 1873. Was laid up in 1874 for repairs.

**KEARSARGE.**—Live-oak ship. In 1869 and 1870 was in the South Pacific fleet. Was laid up in 1871. Repaired in 1872 and '73, very extensively and at great cost. Joined the Asiatic squadron in 1874, and is now on that station.

**WACHUSETT.**—Live-oak ship. Laid up for repairs in 1869. Repaired in 1870 and '71, and joined the European fleet in 1872. Transferred to North Atlantic fleet in 1873, and was laid up for repair in 1874.

**MOHICAN.**—Partly white oak, from repairs made in 1864. Joined North Pacific fleet in 1870. Repairing in 1873, and repairs not completed. Her capacity has been increased, and a live-oak frame has been substituted for partly white-oak. When completed she will be of the same class and dimensions as the *Marion*.

**TUSCARORA.**—Live-oak ship. In 1869 was in the South Pacific fleet, and transferred to the North Pacific squadron in 1870. Laid up for repairs in 1871. Repaired in 1872 and sent on surveying duty in 1873.

Was transferred to North Pacific fleet in 1875, where, she is now on duty.

**WYOMING.**—Live-oak ship. Laid up for repair early in 1869. Repaired in 1870, and put in commission for special duty in 1871. Joined the North Atlantic fleet in 1872. Laid up for repairs in 1874. Has been since repaired, and is now ready for service.

**NARRAGANSETT.**—Live-oak ship. Repairing in 1869. Put in commission and joined the North Pacific squadron in 1871. In 1873, '74, and '75 was employed in deep-sea soundings. Laid up in 1876 for repair.

**ASHUELOT.**—Has been attached to the Asiatic squadron since 1869. During that time has been extensively repaired.

**MONOCACY.**—Iron-hull side-wheel double-ender. Has been attached to Asiatic squadron since 1869. Has been repaired several times during that period.

**KANSAS.**—White-oak ship. In South Atlantic squadron in 1869. Repaired in 1870. In 1871, '72, and '73 was employed in surveying canal-route to the Pacific via Nicaragua and Tehuantepec, and joined North Atlantic fleet in 1874. In 1876 was laid up for repair. Not considered worth repairing.

**NIPSIC.**—White-oak ship. In North Atlantic squadron in 1869. In 1870 and '71 was employed in the Darien surveying expedition for canal-route to Pacific via Isthmus of Darien. In 1872 and '73 was employed in North Atlantic squadron, and in 1874 laid up for repairs. Repairs commenced in 1875, which were to be so extensive and costly that it was considered to be to the interest of the Government to change her frame from white oak to live-oak. Her capacity was increased and model improved, and although the repairs are not yet completed she can be made ready for sea in four months, and will then be of the Adams class with all of the modern improvements.

**SACO.**—White-oak ship. Laid up for repairs in 1869. Repaired in 1870, and joined European fleet 1871. Transferred to Asiatic squadron in 1872, and laid up for repairs in 1876.

**NYACK.**—White-oak ship. In South Pacific squadron in 1869, and in 1871 laid up for repairs, which are required to be very extensive.

**SHAWMUT.**—White-oak ship. Laid up for repairs in 1869. Repaired in 1870 and 1871. Joined the North Atlantic squadron, and is still in service there.

**YANTIC.**—White-oak ship. In 1869 was in North Atlantic squadron, and in 1871-'72 was thoroughly repaired and sent to the Asiatic station. She is still on that station, but has lately been reported unseaworthy, and will require costly repairs, if found worthy of them.

**MICHIGAN.**—Iron side-wheel vessel, in good condition and doing special duty on Lake Erie.

**FROLIC.**—Iron side-wheel vessel. In 1869 used as a dispatch-vessel, European squadron. Thoroughly repaired in 1871, and used as post-admiral's flag-ship. In 1872 doing duty on special service. Returned in 1873, was post-admiral's flag-ship and laid up during 1874, and in 1875 joined the South Atlantic squadron. Is still on that station and in good condition.

**GETTYSBURG.**—Iron side-wheel vessel. In North Atlantic squadron in 1869. Repaired in 1870 and laid up in ordinary. On special service in 1872. Thoroughly repaired in 1873, and put on special duty in 1875. Now employed on surveying-duty. Is in good order.

**TALLAPOOSA.**—White-oak vessel. Side-wheels. In 1869 was put on

special duty carrying materials and stores to stations. In 1874 was thoroughly repaired, and has been since on special duty as before.

**WASP.**—Iron side-wheel vessel. In 1869 was in South Atlantic fleet, where she was employed until condemned in 1875, and has since been sold.

**PALOS.**—Iron tug. Laid up in 1869. Repaired in 1870 and joined Asiatic fleet as tender, where she is employed and in good condition.

**NEW HAMPSHIRE.**—Live-oak sailing-ship, (74.) In 1869, receiving-ship. In 1876, sent to Port Royal as store-ship. In good condition, but can only be of service as store-ship.

**NEW ORLEANS.**—White-oak ship, (74.) On the stocks at Sacket's Harbor, New York. Rotten and unfit for repairs or use.

**OHIO.**—Live-oak sailing-ship, (74.) Used as a receiving-ship until 1875, when she was placed in ordinary, and must be considered of no further use to the Government.

**VERMONT.**—Live-oak sailing-ship, (74.) Was used as receiving-ship until 1875, when she was laid up in ordinary, and is considered of no further use to the Government.

**CONSTELLATION.**—Live-oak sailing-frigate. Laid up in ordinary in 1869. Repaired in 1870 and 1871. In use in 1872 as practice-ship for gunnery. In 1873 and 1874, in commission as practice-ship for naval cadets, and in 1876 laid up in ordinary.

**CONSTITUTION.**—Live-oak sailing-frigate. In 1869, in commission in connection with Naval Academy. Laid up in ordinary in 1872, and since has been under repairs for practice-ship, which are nearly completed.

**INDEPENDENCE.**—Receiving-ship. Live-oak sailing razee-frigate. Rotten, and of no service except for the purpose used.

**MACEDONIAN.**—Live-oak sailing-frigate. In commission as cadet practice-ship in 1869 and 1870, and in 1871 repaired and put in ordinary. Has since been sold.

**POTOMAC.**—Live-oak sailing-frigate. Has been used as receiving-ship since 1869. Is now very rotten and not worth repairing. Will be offered for sale when there is a prospect of obtaining a fair price.

**SABINE.**—Live-oak sailing-frigate. In 1869, laid up for repair. Repaired in 1870 and sent on special service with midshipmen for practice. Repaired in 1871 and 1872 and put in commission as receiving-ship. Laid up in ordinary 1876. Has no value of importance as a fighting-vessel, and will be sold when the market will warrant obtaining a fair price.

**SANTEE.**—Live-oak sailing-frigate. School-ship in 1869, and employed as practice and gunnery ship at Naval Academy since that time. She is in fair condition, and is useful for the purpose for which she is employed.

**SAVANNAH.**—Live-oak sailing-frigate. Laid up in ordinary in 1869. Employed as practice-ship in 1870, and since that time has been laid up. Not of any service except as school or practice ship.

**ST. LAWRENCE.**—Live-oak sailing-frigate. Used as marine barracks from 1867 to 1875, when she was no longer, through deterioration, fit for that service, and has been sold.

**PORTSMOUTH.**—Live-oak sailing-sloop. Repaired in 1869 and sent to South Atlantic squadron in 1871. Was employed in 1873 on surveying duty, and in 1874 and 1875 was employed in North Pacific squadron. Has been employed as a training-ship for boys since that time. She is in good condition.

**CYANE.**—Live-oak sailing-sloop of old type. In 1869, was used as

store-ship, Pacific squadron, and was employed in that service until laid up in 1872. Not considered worth repairing.

**JAMESTOWN.**—Live-oak sailing-sloop. In 1869, employed in North Pacific squadron, continuing on duty until laid up for repairs in 1871. In 1875, was thoroughly repaired and turned over to the city of San Francisco for a training-school, as directed by act of Congress.

**SARATOGA.**—Live-oak sailing-sloop. In 1869, used as a school for naval apprentices. Repaired in 1870, and laid up in ordinary. Put in commission as ordnance practice-ship in 1874, and laid up as unfit for repairs in 1876.

**ST. LOUIS.**—Live-oak sailing-sloop. Old type. Used as officers' quarters at League Island from 1869 to 1875, and since that time as store-ship for the Bureau of Provisions and Clothing. Considered totally unfit for repairs.

**ST. MARY'S.**—Live-oak sailing-sloop. In 1869, was laid up in ordinary. Repaired in 1870, and joined the Pacific squadron, and returning was laid up for repairs. Repaired in 1875, and turned over to the city authorities of New York for State Marine School, as per act of Congress.

**DALE.**—Live-oak sailing-sloop. In 1869, employed as practice-ship at Naval Academy, and has remained in that service ever since. Is in good condition.

**PAWNEE.**—Partly live-oak ship. In South Atlantic squadron in 1869. Returned for repairs in 1870. The cost of repairing her machinery having been found to be too great, it was removed, and she was sent to Pensacola, as store-ship, in 1872. Since that time she has been used as a store-ship at Key West and at Port Royal. Her hull is very rotten, and considered not worth repairing.

**GUARD.**—White-oak sailing-ship. Employed as store-ship in 1869. In 1870 and 1871, employed in the Darien expedition. Laid up in 1872, and sent with goods for the Vienna Exhibition in 1873. Returned in 1874, and was laid up in ordinary. Will require repairs before going to sea. Serviceable only as store-ship.

**ONWARD.**—White-oak sailing-ship. In service as store-ship in 1869, and has been used for that duty in South-Pacific squadron up to the present time. Is only useful for that service.

**RELIEF.**—Live-oak sailing store-ship. Laid up in ordinary in 1869, '70, '71, and '72, and used as receiving-ship since that time. Is now in fair condition, but of no value as a fighting-vessel.

**SUPPLY.**—White-oak sailing-vessel. Laid up in ordinary in 1869, and made a voyage, taking stores to the Vienna Exhibition in 1873. Since that time has been repaired and was sent, in 1875, to Europe for goods for the Centennial Exhibition, bringing to Washington, on her return in 1876, the naval monument. At the present time is laid up in ordinary. Is only serviceable as a store-ship.

### NEW VESSELS ADDED TO THE NAVY SINCE 1869.

**TRENTON.**—Second-rate. Built of live oak, with full steam and fighting power. Of new type for flag-ships. Is being completed and will soon go into commission.

**ADAMS.**—Third-rate. Built of live oak, full steam-power. In commission, and has shown excellent qualities as a man-of-war of her class.

**ENTERPRISE.**—Third-rate. Built of live oak, full steam-power. Will be put in commission as soon as a crew can be obtained.

**ESSEX.**—Third-rate. Built of live oak, with full steam-power. In commission. Report speaks of her as satisfactory in every respect.

**ALLIANCE.**—Third-rate. Built of live oak, with full steam-power. Will be put into commission as soon as a crew can be obtained.

**ALERT.**—Third-rate. Built of iron, with full steam-power. In commission, and of good report.

**HURON.**—Third-rate. Built of iron, with full steam-power. In commission, and of good report.

**RANGER.**—Third-rate. Built of iron, with full steam-power. Ordered into commission.

**ALARM.**—Torpedo-boat. Built of iron, bracket-system, and fitted with a Fowler wheel. Light armor-plated. Double bottom. Carries one 15-inch gun in addition to torpedo-fixtures. Is in good order.

**INTREPID.**—Built of iron, double bottom. Armor-plated on sides of five (5) inches of iron, and two (2) inches over the deck. Arranged for forward under-water torpedo. Machinery all under water-line. Is in good order.

### PURCHASED VESSELS.

**DESPATCH.**—Purchased for quick-dispatch duty. Is very fast and in good condition. Has been usefully employed since her purchase.

**RIO BRAVO.**—Purchased for special service on Rio Bravo River as a very light-draught boat. Is now on that duty.

### GENERAL OPERATIONS OF THE FLEETS.

*European Station.*—The Franklin remained at Lisbon until February 19, on which day she sailed for Southampton, thence to Oberbourg, to take on board the works of art of our citizens in Europe intended for the Centennial Exhibition. Having received the articles, she returned to Gibraltar, where she was met by the Supply, to which the works of art were transferred for transportation to Philadelphia. From Gibraltar the Franklin returned to Villefranche.

Serious disturbances having occurred at Salonica, Turkey, placing the lives of American citizens in jeopardy, Rear-Admiral Worden left in the Franklin on May 16 for that point. So large a vessel as the Franklin not being allowed to pass the Dardanelles, Rear-Admiral Worden himself visited Constantinople and conferred with the United States minister, having also an interview with the Grand Vizier and cabinet ministers of the Porte. The presence of the Franklin not being found necessary at Salonica, she visited Beirut, and returned to Villefranche in July. The Marion arriving shortly afterwards from the United States, she was sent to the Dardanelles, and the proper permit being given, she passed the straits and anchored off Constantinople. She remained there a few days only, and returned to Villefranche, taking the place of the flag-ship, which had received orders for home. The transfer was made September 14, and the Franklin sailed the same day for the United States.

*Asiatic Station.*—Nothing unusual has occurred within the limits of the Asiatic station requiring any other service than is common to cruisers in time of peace. The Kearsarge was sent especially to Manila in July to inquire into the detention by the Spanish authorities of an

American merchant-vessel—the *Fanny Hare*—and to take all proper measures to secure her release. The matter was investigated and the vessel was allowed to pursue her course.

The *Ashuelot* made an interesting visit to Bangkok, Siam, arriving there in April and leaving in May, during which there was a pleasant interchange of courtesies with the officials of the kingdom. She received on board the contributions of the Siamese government to the Centennial Exhibition and conveyed them to Hong-Kong, whence they were shipped by steamer to San Francisco and by rail to Philadelphia, arriving in season to be displayed with other naval exhibits.

Rear-Admiral Reynolds has visited in his flag-ship the chief ports of Japan and China, and given his personal attention to the interests of our countrymen there. He left New Chwang, September 22 for the mouth of the Peiho, where he leaves the *Tennessee* and with his staff visits Peking. The greater part of the force will be stationed between Shanghai and Tient-sin until matters in that quarter are in a more satisfactory condition.

*North Pacific Station.*—At the date of the last annual report of the Department, Rear-Admiral Almy was visiting the ports on the west coast of Mexico in the *Pensacola*. Having spent a fortnight at Acapulco, he sailed in the *Pensacola* for San Francisco December 27, and arrived January 26. Having been detained at the navy-yard several months, she sailed from San Francisco, bearing the flag of Rear-Admiral Murray, for the coasts of Mexico and Central America and the South Pacific station, arrived at Mazatlan September 10, and proceeded thence to La Paz. At the latter place the admiral had occasion to protest against the alleged illegal seizure of certain property belonging to a citizen of the United States, and, in a correspondence with the governor of Lower California, to insist, as far as he was authorized to do so, on its restoration. This affair detained the *Pensacola* until October 10, by which time, it having been taken up by the civil authorities, she left for Acapulco, arriving at the latter port October 21. Although the country at this time was in a revolutionary condition, there seemed to be no indication that the rights of our countrymen would not be respected, and as the *Lackawanna* was daily expected, Rear-Admiral Murray proceeded southward, in pursuance of his instructions, to visit Panama and the ports of the South Pacific station, and assume command temporarily of the naval force in those waters in addition to that in the waters in the North Pacific. After remaining in the South Pacific for such time as the public interests seem to require, he will return with the *Pensacola* to his regular station.

The *Lackawanna* sailed from San Francisco January 25, for Lower California, visiting San Blas, Mazatlan, La Paz, Guaymas, and Acapulco; remained on the coast until April, and then proceeded to Honolulu. This place she made her headquarters, visiting other ports of the Hawaiian dominions, until September, and then returned to the coast of Mexico. A critical period in the political affairs of Hawaii detained her in that quarter. She is supposed to be, at this time, on the Mexican coast, from which she has orders for San Francisco.

The *Tuscarora*, engaged in deep-sea soundings, left Honolulu December 6, to run a line to the Australian coast. This duty, a delicate, and, at the same time, a laborious one, was creditably performed, and she returned to Honolulu May 27, where she remained a short time, then came to Mare Island, where she was put out of commission. On the passage homeward from Australia the commanding officer of the *Tuscarora* made an investigation of the trouble between Mr. Steinberger, former commissioner at Samoa, and the natives of the group.

*South Pacific Station.*—The Richmond has been principally at Callao and Valparaiso or cruising between those ports. Her presence, pending the revolutionary condition of affairs on the west coast of South America, has given encouragement to our citizens there.

The Omaha has been very actively cruising during the past year, having visited all the principal ports, some of them more than once, between Panama and Valparaiso. In March she proceeded to Juan Fernandez and made a survey of the island and its shores. The course of events and the interests of American citizens have been closely watched by Captain Simpson. The Omaha arrived at Panama November 16.

Our vessels and their officers have been well received by the authorities and citizens of the South American Republics, and a spirit of friendship manifested and cordial relations maintained.

*South Atlantic Station.*—Rear-Admiral LeRoy left Rio de Janeiro December 7, and reached Key West January 11, and by virtue of his instructions had for a time the command of the vessels there. He proceeded from Key West by steamer to New York, thence to Hampton Roads, and, February 14, relieved Rear-Admiral Mullany of the command of the force on the North Atlantic Station.

The Monongahela, which sailed from Montevideo November 18, arrived at Key West January 11, and subsequently became a part of the North Atlantic squadron.

The Frolic reached Montevideo, from the United States, December 22, and having taken the place of the Wasp, the latter was sold January 5, it not being to the interest of the Government to repair her out there or to send her home for the purpose.

Commander Wm. A. Kirkland, of the Frolic, since the departure of Rear-Admiral LeRoy, has been looking after our interests in the waters of the La Plata, and extending such facilities to the diplomatic representatives on that quarter as the public service demanded.

The Richmond having arrived on that coast, that vessel and the Frolic now compose the naval force on the South Atlantic Station, in command of Commodore C. H. B. Caldwell.

*The North Atlantic Station.*—Many of the cruisers on this station have been actively and usefully employed during the year, a brief and general statement of which it appears proper to give.

January 5, Rear-Admiral Mullany transferred his flag from the Worcester to the Hartford at Norfolk, and the former was soon put out of commission as a cruiser, and, February 14, his period of service being up, he was relieved by Rear-Admiral LeRoy.

The Department contemplated the concentration at Port Royal of the vessels of this station for general inspection and fleet exercise preparatory to their distribution for the winter months in the West Indies and to other points within the limits of the command. The purpose could not be carried out, as the unsettled condition of political affairs in Hayti and Mexico required an earlier distribution of the squadron than was anticipated.

Information of a probable revolution in Hayti caused the dispatching of the Plymouth and Vandalia March 15, from Hampton Roads, for Port au Prince; and a few days later Rear-Admiral LeRoy left Hampton Roads in the Hartford, accompanied by the Marion and Huron, for Port Royal. Before the separation at Hampton Roads a battalion and howitzer drill was had. There were landed, from the Hartford, Plymouth, Vandalia, Marion, and Huron, eight companies of blue-jackets, 288 men; three companies of marines, 102 men; six howitzers, 126 men; a total of 516 men. The landing was made in good order, and the drill



within Fort Monroe, in the presence of the garrison, was highly satisfactory.

Soon after arriving at Port Royal serious disturbances in Mexico were reported, and Rear-Admiral LeRoy was ordered to proceed with a sufficient force to the gulf coast of that republic for the protection of American citizens and interests. The Hartford, Marion, Huron, and Shawmut were assigned to this duty. By the latter part of April or early in May all had sailed from Port Royal for the principal points on the coast—Brazos, Tampico, and Mexico. Rear-Admiral LeRoy reached Brazos in the Hartford May 9, and as the Marion was there, and the army at Brownsville, in conjunction with the gunboat Rio Bravo, sufficient to protect the frontier, continued on to Tampico, one or more of his squadron having preceded him. He remained off Tampico from the middle of May to the middle of June, and then returned to Port Royal, leaving the Swatara, Huron, and Shawmut—the Marion having previously sailed for the European station—on the coast to give particular attention to localities where the interests of our countrymen were likely to be jeopardized. The flag was shown at Vera Cruz, Tuxpan, Frontera, Tonala, Santa Ana, Tupilco, and Coatzacoalcas. These vessels remained on the coast several weeks, one or another going to Key West for supplies when needed; and as it became important that their crews should have a change of climate, they returned to Port Royal in July and August and were ordered on the eastern coast, some of them as far as Halifax. A number of ports of the New England States were visited by them and the Ossipee and Monongahela, which had been sent north some weeks earlier.

From Port Royal the Hartford proceeded to Philadelphia, arriving July 12, and taking the place of the Congress, which had been there since the opening of the Centennial Exhibition to extend appropriate courtesies to foreign men-of-war.

In compliance with a request of Rear-Admiral Le Roy made some weeks before, he was detached, and relieved, August 31, by Rear-Admiral Stephen D. Trenchard, the present commanding officer of the North Atlantic station. The Hartford was in turn succeeded, September 20, by the Plymouth, and September 26 sailed for Hampton Roads, where Rear-Admiral Trenchard is at present with a part of his command.

The Plymouth, heretofore mentioned as having been dispatched, in company with the Vandalia, to Hayti, arrived at Port au Prince March 26, and the Vandalia the next day. The two vessels remained in the waters of Hayti and San Domingo, with the exception of brief visits to Kingston, Jamaica, for supplies, several weeks, and their presence was of great importance during the revolution in Hayti in April, and is believed to have prevented much shedding of blood. Their commanding officers, by a prudent and intelligent course, served the interests of our Government and gave asylum to political refugees who sought it, without complicating our relations with the dominant party of Hayti or going beyond the strict limits of neutrality.

Our flag was shown at all the principal points on the coasts of Hayti and San Domingo, and there being no further occasion for the presence of either of those vessels, the Plymouth sailed from Samana May 26 for Port Royal, S. C., and the Vandalia about May 8 for Aspinwall, U. S. C. The latter vessel remained at Aspinwall a couple of months, and arrived at New York, via Port Royal, August 2. She was there refitted, and sailed, September 9, for the European station.

The Brooklyn and Monongahela, which joined the North Atlantic sta-

tion in January, were put out of commission, the former at New York and the latter at Norfolk, in July. The latter was recommissioned in September by a transfer to her of the officers and crew of the *Juniata*. The *Alert* was detached in March, refitted at New York, and sailed May 26 for the Asiatic station.

Anticipating a sickly season at Pensacola, the four monitors at that yard, *Saugus*, *Mahopac*, *Ajax*, and *Manhattan*, were moved to Port Royal.

In May, the *New Hampshire*, old line-of-battle ship, having been fitted up for a store-ship at Port Royal, and placed in command of Commodore J. M. B. Clitz, was towed from Norfolk to that point. Commodore Clitz was clothed with the additional authority of senior officer in charge of the vessels in the harbor of Port Royal during any temporary absence of the rear-admiral commanding the station. By direction of the Department the officers and crews of the monitors at Port Royal have maintained a strict routine of exercises and drill, and a recent inspection shows that the vessels are in excellent condition and their crews were under fine discipline. These exercises were for a time suspended in view of the presence of yellow fever in the vicinity.

It is gratifying to be able to state that the officers and men of the squadron at Port Royal have been remarkably healthy, and it may be added that there has not been a case of yellow fever on any one of the large number of vessels in commission on the North Atlantic station during the past year, nor at the Pensacola navy-yard. It is not too much to say that this exemption from so serious a scourge is, no doubt, attributable in a great measure to the care and precaution taken by the commanding officers of the vessels and stations, and the establishment and maintenance of strict sanitary regulations.

The monitors on the North Atlantic station are now located as follows: the *Canonicus* at New Orleans, the *Dictator*, *Ajax*, *Saugus*, *Mahopac*, *Manhattan*, *Lehigh*, and *Catskill* at Port Royal, and the *Montauk*, *Passaic*, and *Wyandotte* at Hampton Roads.

The light-draught side-wheel steamer *Rio Bravo* has been in service on the Rio Grande during the entire year, in charge of a prudent officer, co-operating with the military commandant at Brownsville and the United States consul at Matamoras, and has been a useful adjunct in protecting the frontier against raids, and our citizens at Matamoras during the revolutionary movements in that vicinity. Although the *Rio Bravo* was the best class of vessel that could be obtained on short notice for the service in which she has been engaged, the tortuous course and shallow water of the Rio Grande are great obstacles to her efficiency, and would be, in fact, to the efficiency of any description of vessel not constructed with the especial view of overcoming these difficulties.

The vessels on independent or special service, although not constantly moving, have been in a state of readiness for any sudden emergency, and have been profitably employed. The *Tallapoosa* has made her regular trips between the navy-yards from Washington to Portsmouth, carrying freight and objects for exhibit at the Centennial Exposition, and used in towing monitors from one point to another. The *Powhatan* and *Dispatch* have been also engaged in moving the monitors, and are at all times ready as dispatch or relief vessels; and the latter was for some months stationed at Baltimore as a recruiting-ship for boys. The *Michigan* has made the annual tour of the Lakes, rendering assistance to distressed vessels when possible. The *Juniata*, with enlisted boys under training, has made a cruise to the Bermudas and through Long Island Sound, touching at some ports seldom visited by our men-of-war, and up

the Delaware to Philadelphia, thus giving the youths on board practical exercise in their profession at sea. The Supply, after returning from the Mediterranean, bringing the exhibits of American artists in Europe to Philadelphia, received a complement of boys from the training-ship at New York, and made a practice-cruise as far east as Boston. The Gettysburgh was engaged until June in establishing the exact positions by telegraphic comparison, of important points in the West Indies; and having been refitted at Washington, sailed in September for the Grecian Archipelago to conduct surveys and examinations desired by the Bureau of Navigation. The Constellation and Mayflower have made the usual practice-cruise with the cadets; and the Rio Bravo has been usefully employed, as before stated, on the Rio Grande.

Altogether, taking into consideration the reduction in the number of men and naval appropriations, the operations and movements of our vessels during the past year compare favorably with those of any other in time of peace.



# APPENDIX.

## No. 1.

### ESTIMATES SECRETARY'S OFFICE.

*Estimates of appropriations required for the service of the fiscal year ending June 30, 1878, by the Navy Department.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>SALARIES.</b>		
Secretary, (appropriated,) per act of August 15, 1876 .....	\$8,000	.....
Chief clerk, (appropriated,) per act of August 15, 1876 .....	2,500	.....
Disbursing-clerk, (appropriated,) per act of August 15, 1876 .....	2,000	.....
Four clerks of class four, (appropriated,) per act of August 15, 1876 .....	7,200	.....
Three clerks of class three, (appropriated,) per act of August 15, 1876 .....	4,800	.....
One clerk of class three, (submitted) .....	1,600	.....
One clerk of class two, per act of August 15, 1876 .....	1,400	.....
One clerk of class two, (submitted) .....	1,400	.....
Two clerks of class one, per act of August 15, 1876 .....	2,400	.....
One clerk of class one, (submitted) .....	1,200	.....
Two messengers, at \$840 each, per act of August 15, 1876 .....	1,680	.....
Two laborers, at \$720 each, per act of August 15, 1876 .....	1,440	.....
	<b>35,620</b>	<b>\$31,420</b>
<b>CONTINGENT EXPENSES.</b>		
Stationery, furniture, newspapers, and miscellaneous items, (appropriated) .....	5,000	2,500
<b>SALARIES, BUILDING.</b>		
Superintendent, per act of August 15, 1876 .....	250	.....
Five watchmen, at \$720 each, per act of August 15, 1876 .....	3,600	.....
Two laborers, at \$720 each, per act of August 15, 1876 .....	1,440	.....
	<b>5,290</b>	<b>5,290</b>
<b>CONTINGENT EXPENSES, BUILDING.</b>		
Incidental labor, fuel, light, and miscellaneous items, (appropriated,) per act of August 15, 1876 .....	7,000	5,000
<b>POSTAGE, NAVY DEPARTMENT.</b>		
For official postage-stamps for the Secretary's office and the bureaus of the Navy Department, (appropriated,) per act of August 15, 1876 .....	20,000	20,000
<b>PAY OF THE NAVY.</b>		
For pay of the officers and men of the Navy, according to existing laws and the established custom of the service, for the year ending June 30, 1877, being the difference between the sum of \$7,300,000, required for that purpose, and the sum of \$5,750,000 appropriated therefor, (submitted) .....	1,550,000	.....
<b>CONTINGENT, NAVY.</b>		
Rent and furniture of buildings and offices not in navy-yards; expenses of court-martial and courts of inquiry, boards of investigation, examining boards, with clerks and witnesses' fees, and travelling expenses and costs; stationery and recording; expenses of purchasing-paymasters' offices at the various cities, including clerks, furniture, fuel, stationery, and incidental expenses; newspapers and advertising; foreign postage; telegraphing, foreign and domestic; copying; mail and express wagons, and livery and express fees, and freight; all books for the		

*Estimates of appropriations required for the service of the fiscal year, &c.—Continued.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
use of the Navy; experts' fees, and costs of suits; commissions, warrants, diplomas, and discharges; relief of vessels in distress, and pilotage; recovery of valuables from shipwreck; quarantine expenses; care and transportation of the dead; reports, professional investigation, and information from abroad; and all other emergencies and extraordinary expenses arising at home or abroad, but impossible to be anticipated or classified. (appropriated,) June 30, 1876, (Stats. at L., page 66, section 1) .....	\$100, 000	\$80, 000
CIVIL ESTABLISHMENT, NAVY-YARDS AND STATIONS.		
For the civil establishment at the various navy-yards and stations, (appropriated,) (Stats. at L., page 66) .....	160, 000	85, 000

## No. 2.—NAVAL ACADEMY.

### REPORT OF THE SUPERINTENDENT.

#### UNITED STATES NAVAL ACADEMY,

*November 17, 1876.*

SIR: At the Naval Academy, during the past year, the prescribed course of studies has been pursued satisfactorily, and the professors and officers under my command have devoted themselves with skill and assiduity to the discharge of their duties.

The practice cruises in the *Constellation* and *Mayflower* were very successful, and the cadet-midshipmen saw more practical work in handling a ship under canvas than they would have seen in an ordinary cruise of three years in a ship of war on foreign service.

I beg to renew, in the most urgent terms, the two recommendations I made last year:

1st. That the system pursued at West Point, of appointing cadets at least one year before they shall present themselves for admission, be adopted at the Naval Academy.

2d. That Congress be moved to make the necessary appropriation to build an additional wing to the new cadet quarters, so that the cadets may be quartered under one roof, to the great benefit of their discipline, their health, and the economy of the administration of the school.

The evil practice of "hazing," to root out which Congress enacted a special law, and against which the Navy Department has directed the most stringent orders, still continues to find favor among the young men of our country, and has not disappeared from this school.

The instinct of a naval officer should teach him to be courteous to strangers, to protect the friendless, and to welcome with kindness and consideration those entering his own profession; but, unfortunately, the cadets who have already been one or two years at the Naval Academy affect to consider it necessary to their own dignity that the new-comers should be taught to pay the classes above them great deference, and with that view they harass and insult them by petty indignities and by a small tyranny, which, if not promptly and severely dealt with, soon grows into graver oppression.

This assumption of unauthorized authority, and this wanton rudeness

to the lads fresh from home—this brutal combination, by which a class insults an individual who does not dare defend himself lest he be overwhelmed by numbers, is a false element of naval education which it is my duty to root out of this establishment.

That the cadets here, beneficiaries of the Government, educated and paid by it, sworn, moreover, to obey its laws, who can render no return save obedience for the great benefits their country gives them, should presume to set at naught its laws and its injunctions, is not to be permitted.

I have, therefore, caused to be arraigned before a court-martial those cadets presented for trial by an investigating board, charged to make inquest into the violations of the laws enacted by Congress to prevent hazing at the Naval Academy, approved June 23, 1874. At the beginning of the present academic year the cadets were again warned of the consequences of hazing by the following general order, but, unhappily, their idea that discipline would be better advanced by procuring deference to themselves from the entering cadets than by their own submission to the law and to the orders of those placed over them, led them once more into the old hazing combination.

[Order No. 103.]

UNITED STATES NAVAL ACADEMY,  
*Annapolis, Md., September 14, 1876.*

For the information of the cadets, the law in relation to hazing at the Naval Academy is herewith republished.

The cadets are also reminded of the painful experience of last year, and of the dismissal of several of their number for this offense of hazing, which they vainly sought to disguise under the name of "running."

The new cadets are not to be maltreated, harassed, rendered ridiculous, subjected to indignities, or in any way molested, on penalty of being arraigned before a court-martial upon the charge of hazing.

C. R. P. RODGERS,  
*Rear-Admiral, Superintendent.*

The following is the act of Congress, approved June 23, 1874 :

#### *Hazing.*

CHAPTER 453.—An act to prevent hazing at the Naval Academy,

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That in all cases where it shall come to the knowledge of the Superintendent of the Naval Academy at Annapolis that any cadet-midshipman or cadet-engineer has been guilty of the offense commonly known as hazing, it shall be the duty of said Superintendent to order a court-martial, composed of not less than three commissioned officers, who shall minutely examine into all the facts and circumstances of the case and make a finding thereon; and any cadet-midshipman or cadet-engineer found guilty of said offense by said court shall, upon recommendation of said court, be dismissed: and such finding, when approved by said Superintendent, shall be final; and the cadet so dismissed from said Naval Academy shall be forever ineligible to re-appointment to said Naval Academy.

Approved June 23, 1874.

With this unfortunate attempt was connected the hope that by agreeing to refuse to testify when inquest should be made the inquiry would be baffled and investigation defeated.

Several of the third class (afterward known to have been seriously implicated in the hazing) refused to give evidence against their fellow-cadets.

It was gravely and kindly explained to them that they need not criminate themselves, but that the law would, on no other grounds,

permit any one to refuse to testify before such an inquest; and they were warned of the probable consequence of their contumacy.

They still refused. Their conduct was referred to the Navy Department; and that Department warned them that the questions were lawful and proper, and must be answered, upon pain of dismissal. The views of the Navy Department were read to them; the article of war which requires every person in the Navy "to use his utmost exertions to detect, apprehend, and bring to punishment all offenders, and aid and assist all persons appointed for that purpose," was also read.

They were again interrogated; and they again refused to give evidence, and were dismissed.

\* Some others, who were not afterward shown to have taken part in the "hazing," but who probably gave it their countenance, were dismissed under the same circumstances and after the same warnings.

Paragraph 170 of the regulations of the Naval Academy, approved January 1, 1876, is as follows: "170. \* \* \* The practice of molesting, annoying, ridiculing, maltreating, or assuming unauthorized authority over the new cadets of the fourth class, known under the term of "hazing," "running," &c., shall subject the older cadets to prompt dismissal from the Naval Academy, as prescribed by the act of Congress and the orders of the Secretary of the Navy."

I have the honor to be, very respectfully, your obedient servant,

C. R. P. RODGERS,

*Rear-Admiral, Superintendent.*

Hon. GEORGE M. ROBESON,  
*Secretary of the Navy.*

*Estimates of appropriations required for the service of the fiscal year ending June 30, 1878, by the Naval Academy.*

Detailed object of expenditure and explanation.	Estimated amount which will be required for each detailed object of expenditure.
<b>NAVAL ACADEMY.</b>	
<i>Pay Naval Academy:</i>	
One professor of drawing, (head of department) .....	\$2,500 00
One professor of modern languages, (head of department) .....	2,500 00
Three professors, viz, one of physics, one of chemistry, and one of Spanish, at \$2,200 each .....	6,600 00
Nine assistant professors, viz, four of French, three of English studies, history, and law, two of drawing, at \$1,800 each .....	16,200 00
Sword-master, at \$1,500, and two assistants, at \$1,000 each .....	3,500 00
Boxing-master and gymnast .....	1,200 00
Assistant librarian .....	1,400 00
Three clerks to superintendent, at \$1,200, \$1,000, and \$800 each .....	3,000 00
One clerk to commandant of cadets .....	1,000 00
One clerk to paymaster .....	1,000 00
One apothecary .....	750 00
One mess-man, at \$255; one cook, at \$325.50; and messenger to superintendent, at \$600 .....	1,213 50
One armorer, \$529.50; gunner's mate, at \$469.50; and quarter-gunner, at \$409.50 .....	1,408 50



*Estimates of appropriations required, &c.—Continued.*

## Detailed object of expenditure and explanation.

Estimated amount which will be required for each detailed object of expenditure.

One coxswain for gymnasium, at \$469.50; one seaman in department of seamanship, one seaman in department of astronomy, &c., and one seaman in department of physics and chemistry, at \$349.50 each.....	\$1,518 00
One band-master, at \$528; and twenty-one first-class musicians, at \$348 each.....	7,836 00
Seven second-class musicians, at \$300 each.....	2,100 00
	53,726 00
Amount appropriated under this head, "Pay of professors and others," for the year ending June 30, 1877 .....	55,526 00
Decrease .....	1,800 00
<i>Pay of watchmen and others :</i>	
Captain of the watch, at \$2.50 per diem.....	\$912 50
Four watchmen at \$2.25 per diem each.....	3,225 00
Foreman of the gas and steam-heating works of the Academy, at \$5 per diem .....	1,825 00
Ten attendants at gas and steam-heating works, one at \$3.50, one at \$3, and eight at \$2.50 per diem each.....	9,672 00
One steam-pipe fitter, at \$1 per diem.....	365 00
Three joiners, two painters, and two masons, at \$3.50 per diem each.....	8,942 50
One tinner, one gas-fitter, and one blacksmith, at \$3.50 per diem each.....	3,832 50
	28,834 50
Amount appropriated for the year ending June 30, 1877.....	28,834 50
<i>Pay of mechanics and others :</i>	
One mechanic at workshop, at \$2.25 per diem.....	\$821 25
One master-laborer to keep public grounds in order, at \$2.28 per diem.....	832 20
Fourteen laborers to assist in the same, three at \$2 and eleven at \$1.75 per diem each.....	9,216 25
One laborer to superintend quarters of cadets, public grounds, &c., at \$2.28 per diem.....	832 20
Six attendants: one at chapel, one at recitation-hall, one at offices, one at library, one at paymaster's office, and one at store, at \$20 per month each .....	1,440 00
Twenty servants to keep in order and attend to cadet quarters, public buildings, &c., at \$20 per month each.....	4,800 00
	17,941 90
Appropriated for the year ending June 30, 1877.....	17,461 90
Excess .....	*480 00
<i>Pay in department of Steam-Engineering :</i>	
One machinist, at \$3.50 per diem.....	\$1,277 50
One machinist, at \$3 per diem.....	1,095 00
One blacksmith, at \$3.50 per diem.....	1,277 50
One boiler-maker, at \$3.50 per diem.....	1,277 50
One pattern-maker, at \$3.50 per diem.....	1,277 50
One molder, at \$3.50 per diem.....	1,277 50
Two laborers, at \$1.75 per diem each.....	1,277 50
	8,760 00
Total .....	8,760 00
Appropriated for year ending June 30, 1877.....	8,760 00

\* This excess is occasioned by two additional attendants, one at the paymaster's office and one at the store.

*Estimates of appropriations required, &c.—Continued.*

Detailed object of expenditure and explanation.	Estimated amount which will be required for each detailed object of expenditure.
<b>REPAIRS AND IMPROVEMENTS.</b>	
For the necessary repairs of public buildings, pavements, wharves, and walls inclosing the grounds of the Naval Academy, for improvements of the same, and for furniture, fixtures, &c. ....	\$24,000 00
Appropriated for the year ending June 30, 1877 .....	24,000 00
<i>For heating and lighting :</i>	
For fuel, for heating and lighting the Academy and school-ships .....	\$18,000 00
Appropriated for the year ending June 30, 1877 .....	18,000 00
<b>GENERAL MAINTENANCE NAVAL ACADEMY.</b>	
For the purchase of books for the library .....	\$2,000 00
For stationery, blank-books, models, maps, &c., and for text-books for the use of instructors .....	2,000 00
For the expenses of the board of visitors .....	2,600 00
For the purchase of chemicals, apparatus, and instruments in the department of physics and chemistry, and for repairs of the same .....	5,000 00
For the purchase of gas and steam machinery, steam pipe and fixtures, rent of buildings for use of the academy, freight, cartage, water, music, musical and astronomical instruments, uniforms for the bandsmen, telegraphing, and for feed and maintenance of teams, and for the current expenses and repairs of all kinds, and for incidental labor and expenses not applicable to any other appropriation .....	34,600 00
For stores in the department of steam-engineering .....	800 00
For materials for repairs in steam-machinery .....	1,000 00
Total .....	48,000 00
Appropriated for the year ending June 30, 1877 .....	45,000 00
Excess .....	*3,000 00

**RECAPITULATION.**

Pay of professors and others .....	\$53,726 00
Pay of watchmen and others .....	28,834 50
Pay of mechanics and others .....	17,941 90
Pay in department of steam-engineering .....	8,760 00
Repairs and improvements .....	24,000 00
Heating and lighting .....	18,000 00
General maintenance .....	48,000 00
Amount estimated for .....	199,262 40
Appropriated for year ending June 30, 1877 .....	137,582 40
Excess .....	1,680 00

Respectfully submitted.

C. R. P. RODGERS,  
Rear-Admiral, Superintendent.

Hon. GEO. M. ROBESON,  
Secretary of the Navy, Washington, D. C.

\* This excess is occasioned by an increase of \$500 for the purchase of books for the library, making it the same as heretofore appropriated, and an increase of \$2,500 for the purchase of chemicals and apparatus for use in the department of physics and chemistry.

## REPORT OF BOARD OF VISITORS.

UNITED STATES NAVAL ACADEMY,  
*Annapolis, Md., June 20, 1876.*

Hon. SECRETARY OF THE NAVY :

SIR: In accordance with your instructions, the Board of Visitors assembled at the Naval Academy, on the 10th of June, and organized by electing Commodore Daniel Ammen as president, and General R. B. Potter as vice-president. All of the members were present except Chief Engineer Lawton, U. S. N. Ensign Austin M. Knight, U. S. N., was detailed as secretary. To accomplish the objects sought by the appointment of the Board, committees were designated to note the examinations, to inspect the grounds, and to inquire into the administration of the affairs of the institution.

## GROUNDS, BUILDINGS, AND SANITARY CONDITION.

The condition of the grounds made a most favorable impression. The well-kept and capacious lawns, the shady and retired walks, present a scene of quiet beauty peculiarly adapted for the recreation of the cadets, and conducive of that repose necessary for a healthful mental development. Except in cases to which allusion will be made, the buildings seemed to be admirably fitted for the purposes intended, and in a proper state of repair. The armory, however, is not suitable. The building is old, and it is the opinion of the Board that a wise economy demands the erection of a new edifice as soon as practicable. While the Board was pleased with the hall which contains the steam-engine, of beautiful workmanship, employed in giving the cadets practical instruction, the shops of the engineers are too cramped, and require enlargement. The efficiency of the institution is to some extent impaired by the necessity of quartering the cadets in buildings at opposite ends of the grounds. It seems very desirable that there should be an addition to the new quarters sufficiently large to accommodate all under one roof. Under the present method it is impossible to make an appropriate division, and an increased force of officers is required to maintain the proper discipline. The hospital is capacious and beautifully located, but, owing to the salubrity of the situation, has but few inmates. In times of war or epidemic it may be useful.

## ADMINISTRATION AND POLICE.

Discipline is merely the subordination of individuals for the promotion of the common weal. It can be maintained without harshness of voice or severity of expression. The system of Martinet, an officer in the army of Louis the Fourteenth, is not adapted for the development of a naval officer of the Republic, and we were gratified that it was not in use at the Naval Academy. While the Board is convinced that the discipline is firm, it has been gratified to see the paternal interest of the admiral, at the head of the institution, in the welfare of his wards, and the kind bearing of the subordinate officers toward those under their care. It has also been pleasant to observe that cadets, during hours of recreation, are encouraged to visit the families of the officers, and thereby receive the social culture which cannot be attained by the study of any text-book.

## LIBRARY.

The library is admirably grouped in an old mansion within the inclosure, long the residence of the governors of Maryland. The rooms at present are ample and convenient, but the day is not far distant when there will be a demand for more space, and then a fire-proof building should be erected. The library receives a general supervision from the superintendent and a committee of officers. It contains works of reference adapted to the wants of the several departments, and also a good collection of voyages, histories, biographies, and magazines for the use of the cadets and families of officers. The constant discoveries in the arts and sciences require yearly accessions to preserve the value of the collection, and all moneys appropriated for this purpose increase the intelligence of our naval officers, who represent us among the nations, in distant climes.

## EXPENSES OF CADETS.

The Board has devoted some time to an examination of the expenses of cadets. The naval store is supplied with goods purchased at wholesale prices, and these are furnished at original cost, with a small percentage added, to cover the expense of transportation and delivery. Owing to the change of professors, and the introduction of new works, there has been some accumulation of books on the shelves, but measures have been adopted by which this will hereafter be avoided.

## PRACTICAL INSTRUCTION.

Theoretic instruction in the class-rooms is fully supplemented by practical exercises. Those members of the board who are versed in seamanship were particularly pleased with the evolutions of the cadets. Great precision was noticed in the infantry and light-artillery drills, in the loading and discharge of the heavy guns on board of the "Santee," in the handling of yards and unfurling of sails and in the conveying of messages by a system of signals.

## MISCELLANEOUS RECOMMENDATIONS.

The Board wholly approves of the recommendation of last year, that appointments be made for the Naval Academy a year before the cadets present themselves for examination. By the adoption of this course, appointees will have time to make the preparation required, and a larger number be spared the mortification of failure. The tables accompanying the report show that the percentage of those admitted, to those who graduate, is 46, and that the average age of admission is 16½ years.

It is further suggested that an alternate be designated, who, in case of the failure of the principal, shall be entitled to an examination, and that each applicant shall be sixteen years of age. The Board has observed with gratification that an accurate physical record has been commenced by the surgeon of the academy, Dr. Gihon, by which the growth and development of the cadets may be carefully studied and compared with that of other classes of young men. This record is based upon the following schedule of inquiries:

1. Class.
2. Date of examination.
3. Name.
4. Nativity.

5. Date of birth.
6. Weight.
7. Height, vertex to ground, and to perinæum.
8. Circumference of thorax, at inspiration and at expiration.
9. Capacity of lungs, (by spirometer.)
10. Circumference of waist.
11. Muscular power, (by dynamometer,) lifting and hauling.
12. Vision.
13. Complexion.
14. Sickness.

The Board is of opinion that the discipline of the academy requires great caution in the exercise of the right to restore cadets who have resigned under censure, or who have been dropped under the regulations.

We would not perform our whole duty if we concluded the report without alluding to the foresight of the President, and Secretary of the Navy, in the selection of so efficient a superintendent, and in the appointment of the aids and academic staff. From all the officers we have received great courtesy, and been assisted by them in the performance of our duties.

The board has been composed of representatives of the States bordering on the Atlantic and Pacific coasts, the rivers of the extreme South and the sources of the Mississippi, and in all their deliberations they have been animated by the same pride in and love for the Republic, and a desire to promote the welfare of the United States Naval Academy whose graduates are already so favorably known among the nations of the earth. The institution has been freely opened to its inspection, and every facility offered the board in the discharge of its duty.

All of which is respectfully submitted.

DANIEL AMMEN,  
*Commodore and President of Board.*  
 ROBERT B. POTTER,  
*Vice-President of Board.*  
 D. C. GILMAN, *Maryland.*  
 S. L. PHELPS, *District of Columbia.*  
 OLIVER ELDRIDGE, *California.*  
 WILLIAM N. JEFFERS,  
*Captain United States Navy.*  
 A. J. EDGERTON, *Minnesota.*  
 T. BAILEY MYERS, *New York.*  
 EDWARD O. ANDERSON, *Georgia.*  
 EDWARD D. NEILL, *Minnesota.*

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ADDRESS TO THE GRADUATING CLASS, ANNAPOLIS, JUNE 20, 1876.

BY DANIEL C. GILMAN,

*President of the Johns Hopkins University, Baltimore, and member of the board of visitors to the academy for 1876.*

#### YOUNG GENTLEMEN OF THE GRADUATING CLASS:

Soldiers and sailors are not fond of long speeches. With them it is a word and a blow; deeds, not essays, are the language they prefer. "I came, I saw, I conquered;" "England expects every man to do his duty;" "Forward and fight;" by such pithy sayings they make reports and give commands.

So before this nautical assembly my words must be brief; but you will, I am sure, grant me some grace because of the triple message I bring.

First, as a member of this board of visitors, and by their request, I tender to you all, from the chief in command to the youngest cadet, our praise and thanks. Be assured that these observers from New York and California, from Georgia and Minnesota, are alike impressed with the nautical skill, the mental power, and the honorable character developed here.

Intelligent citizens in every part of the land are familiar with the history, methods, and results of this academy. They believe in it; they hope in it; they glory in it. They welcome to the public service each new band of graduates—glad and proud that the officers of the Army and Navy are so well trained at West Point and Annapolis, that neither the flag nor the finances of the country will suffer in the hands of such guardians; and hoping that the civil service will never be inferior.

As the official visitors of this year, we have seen more than most of our fellow-citizens can ever see of the methods by which such results are secured, and we add our testimony to that of others in praise of the scholarship, the seamanship, and the manliness, moral and physical, which are here promoted. In years of danger these graduates will be our defense; in years of peace our representatives throughout the globe.

Again, as a college officer, let me express the recognition which is paid by men of science, near and far, to the professors and graduates of the Naval Academy, and let me assure you of the fraternal spirit which is cherished for all who are here trained. Naval officers sometimes feel that their careers, particularly in peace, are unobserved and uncared for. Their duties call them to distant ports, where they see but seldom their countrymen; but let me assure you that they are not forgotten. Their contributions to science, their influence upon the advancement of civilization, their representative character, are never overlooked by educated men.

Sometimes, too, the colleges have a reciprocal action on the Navy. As I recall what this academy has done for science, you will gladly remember, I am sure, that it was a graduate of Columbia, Alexander Hamilton, who first suggested the Naval School; a graduate of Harvard, George Bancroft, who decreed its existence by a ministerial act which showed true statesmanship; a graduate of Yale, William Chauvenet, who shaped its scientific courses; and a graduate of Dartmouth, James W. Grimes, whose influence secured its restoration to this place, when counter-influences would fasten it upon a distant shore.

Once more, I salute you in behalf of this galaxy of mothers, sisters, friends—those bright particular stars—who will watch your course unceasingly like the constellations of the heavens. We hear it said that chivalry went out of modern society when gunpowder came in; but it is not so. With the helmet and the coat of mail, the tournament and the duel are gone, let us hope, forever; but the essentials of chivalry—loyalty, fidelity, and courtesy, the defense of the weak, bravery before danger, the homage of the pure and gentle, and the maintenance of personal honor—these principles still rule in our service. These fair faces, watching your naval jousts, as the tournaments were watched of old, rejoice as you win the sword and epaulets, and bid you be true chevaliers, more knightly, because more enlightened, than those whose exploits are recorded by the ancient chroniclers. They give you the greetings which belong to knights on the eve of battle and in the hour of victory, "Be faithful, bold, and fortunate."

Here my message is closed and my speech might be concluded, but other thoughts ask utterance amid all the associations of this place before we part.

I shall not, though the centennial year suggests it, attempt to review the naval history of this country. Were I to name all the heroes from Paul Jones to Du Pont and Farragut, and all the cruises from that of the Alfred to that of the Franklin, the list would exceed that of the famous catalogue of ships and captains which Homer has handed down to us. Brave achievements and brave men are not forgotten by the young in the romantic period of their lives. A very slight inspection of yonder library shows the well-worn pages of naval biography.

But I cannot forget that you begin your careers, young men, in the time of peace; our last danger of collision with a naval power having been averted by the principle of arbitration successfully maintained by a President whose fame was won in war.

Now peace, as well as war, breeds heroes. You need only glance at the monuments on these walls to observe that danger is always hovering near the sailor. Were these tablets chosen for the purpose, they could not be more typical:—there, the fierceness of the elements is commemorated; there, the treachery of the savage; there, the pirate's deadly blow; and on them all the bravery of those who were lately here. I confess that the heroism (recorded on yonder slab) of Talbot and his party who for fifteen hundred miles were in combat with the elements that they might bring relief to their comrades, and who died as they reached the shore, seems to me as worthy of epitaph and song as any battle action. The surgeon, the captain, or the chaplain, who faces grim pestilence and contagion for weeks and months, that he may relieve his ship-mates, is as worthy of tribute as he who directs the guns and wins the battle.

Towards die many times before their deaths,  
The valiant never taste of death but once.

But the battle is not always with the elements, nor with the enemy, nor with disease. There are daily foes to be met, more treacherous, more deadly, more persistent. The chief of these is idleness, which brings in its train a host of ills. It is easily routed by a love of knowledge. I know very well that life at sea is full of interruptions, as it is of danger, but science and literature abound in illustrations of victories against such obstacles; and the service is now so ordered, with its repeated and careful examinations, that the officer does not fulfill his round of duties unless he prosecutes in some form or other the studies here begun.

It is a satisfaction to hear from those who are in positions of rank and authority in the Navy Department that there is always a demand for specialists; so that no young officer who feels a special drawing toward some branch of the service need fear that his talents and attainments will be overlooked. There are, as it were, graduate places open to those who have left this institution, in the Torpedo school, the Hydrographic Office, the Academy instructorships, the Observatory, the Nautical Almanac Office, in all of which positions the training of a cadet may be carried forward to higher perfection.

If we look for the earliest entrance of the American Navy upon a foreign sea, we shall discover that a hundred years ago a brig of sixteen guns, named the Reprisal, set sail from Delaware Bay for a port in France. It carried, as a passenger, a gentleman of seventy years of age, said, by a French contemporary historian, to join "the spirit of

Socrates to the demeanor of Phocian," and with him were two grandsons, seven and seventeen years of age, doubtless the earliest cadets of the Navy. Delayed by contrary winds, chased by the British cruisers, capturing two prizes, the ship completed her voyage in somewhat more than a month, not a day of which was passed by the venerable passenger without some scientific observations, in the face of all the untimely interruptions. This philosopher was Benjamin Franklin; and his researches respecting the temperature of the ocean laid the foundation of our exact notions of the Gulf Stream, and of the modern investigations by which the *Tuscarora* and the *Challenger* are throwing light upon the distribution of marine life. So, my friends, our Navy in its first transatlantic voyage was the ally of science; so it is now; so may it ever be. Fitly is the name of Benjamin Franklin borne on the flag-ship of our European squadron, commanded by the admiral under whose superintendence this graduating class began their studies here.

We cannot rejoice too much in the union of navigation and science thus auspiciously inaugurated in the earliest oceanic voyage of our Navy, nor be too familiar with the obligations which we owe to a century of officers, not only for what they have won and defended by their bravery, but for what they have by their science observed, recorded, interpreted, and promoted.

Consider for a moment the peaceful scope of the naval service.

For example, we approach the Atlantic seaboard in fog or storm, sure of our nearness to the land by observations of the Gulf Stream, which Franklin instituted, and which his descendant, the head of the Coast Survey, has elaborated and reduced to scientific laws; then we praise the Coast Survey as a branch of the civil service, and we praise it rightly; but we remember that scores of naval officers have been attached to its staff. We speak of the Astronomical Observatory at Washington as a national foundation, and so it is; but the astronomers who use that majestic lens, and interpret to us its accurate revelations, are professors in the Navy, under the superintendence of an admiral distinguished alike in peace and war. We cross the broad Pacific, guided by the stars in their courses, grateful for the ephemeris which is calculated by an officer of the Navy. When we send a message by cable to our antipodes, we owe our thanks to the young lieutenant whose ingenious invention made the deep-sea soundings so trustworthy, and his contemporary in the service, who surveyed the submarine plateau from Newfoundland to Ireland. As we ascend the Chesapeake at night, guided by the colored lights which crown the headlands with a coronet of emeralds and rubies, we are conscious of our obligations to the Light-House Board, of which the naval officers are such efficient members. We study the chief hand-book of American geology, and it reminds us that its author, Dana, was a professor of mathematics in the Navy, and was the companion of Wilkes in his voyage around the globe more than thirty years ago, as ten years previous Darwin had been the scientific companion of Fitz Roy in the *Beagle*. We admire the bronzes and the lacquered ware which Japan sends to the Centennial; we see her influences reflected in European art, and in our own domestic decorations, and we involuntarily think of the naval expedition by whose wise conciliation the island Empire of the Sun was opened to the West.

Recall the chieftains in these and kindred enterprises.

Now it is Wilkes, leading an exploring expedition around the globe, and adding to the science of the world the researches of Dana and his colleagues; now it is Porter, representing his country as their minister resident in Constantinople; now it is Perry, carrying the good will of



America to the distant island of Japan; now it is Maury, studying the log-books of every ship and sea, that he may deduce the laws of winds and currents; now it is a young lieutenant, De Haven, seeking to relieve the Franklin party in the Arctic Seas, or the young surgeon Kane, carrying the flag to the remotest seas of the north; now it is Foote, suppressing the slave-trade upon the coast of Africa; now it is Lynch, exploring the Dead Sea and the Jordan; now Brooke, devising an apparatus for deep-sea sounding not yet superseded; now it is Berryman, discovering the telegraphic plateau; now it is Herndon and Page, opening the rivers of South America; now Selfridge, Schufeldt, and Lull, surveying the routes of an interoceanic canal; now it is Hubbard, watching the stars by night and visiting the hospital by day, till his life is exhausted by this double strain; now it is Belknap, sending his pianowires to the bottom of the Pacific, discovering the submarine peaks and plains, and mapping lands never seen by mortal eye—a veritable Columbus of the deepest sea-soundings; now it is a corps of engineers, studying the laws of heat and steam; now an ordnance corps, measuring the force and velocity of projectiles; now a chronometric party in the West Indies; and now a staff of astronomers, ranking with the greatest men of their times, observing in Washington the movements of the stars, or traversing sea and land for observations of an eclipse or transit.

Young gentlemen of the graduating class, in such a noble lineage as the American Navy you are now enrolled. It was not your birthright, nor have you won your rank by favoritism or purchase. Talent introduced you; obedience and industry promoted you. The severe discipline to which as cadets you have been subjected is intended to secure “the survival of the fittest;” so that we may indeed congratulate the chosen few who have completed this course.

Now comes the voyage and the battle: “Acquit you like men; be strong.” Remember wherever you go that the Navy blue represents the United States of America. You will carry the flag to the most distant sea-ports; you will wear your swords among the brave and cultivated of every nation; you will bear the torch of science to regions unexplored; you will maintain our escutcheon firm and bright in every quarter of the globe; but be mindful always that the Navy, more than any other organized corps, exhibits to the world the manners, the morals, the learning, the wisdom, and the courage of this country. You assume great responsibility, but, like those who have gone before you, you will bear it well.

“No man here  
O Thoas, seems blame-worthy; for they all  
Are skilled in war; nor does unmanly fear  
Hold any back; nor from the difficult strife  
Doth sloth detain one warrior.”

You leave your homes to form a home on shipboard, there, as you rise in command, to oversee the health, the occupations, and the welfare of large bodies of men; you leave your native land to carry its arms and its insignia to other shores, that every wanderer, the merchant or the missionary, the sailor or the traveler, when he sees the flag, may feel protected beneath its folds, his heart beating quick and his eye moistening when he thinks of the home and the Union its colors represent.

As I began with a triple message, I would offer you, in conclusion, a triple garland. Here are laurels from the board of visitors, representing for a moment the citizens of this land. Here are olive-leaves, sacred to Minerva, the symbols of learning and industry; accept them as the tokens of fraternity from other colleges and seats of learning. And

here, most precious of all, are the ivy-leaves of friendship, interspersed with the forget-me-not of affection, which these officers, these relations, and these friends—fair women and brave men—have woven for you. With these triple wreaths begin your voyages, and the blessings of Heaven attend you. Farewell.

#### CRUISE OF THE CONSTELLATION.

UNITED STATES NAVAL ACADEMY,  
*Annapolis, Md., September 27, 1876.*

SIR: I have the honor to submit the following report of the practice-cruise of the *Constellation*, under my command, during the past summer.

On the 21st of June, 47 cadet-midshipmen of the first class, 1 of the second class, and 57 of the third class embarked at this place.

The following officers were detailed for duty on board, viz:

Lieutenant-Commander Silas W. Terry, executive officer.

Lieutenant-Commander B. H. McCalla, navigator.

Lieutenant James H. Dayton, watch-officer.

Lieutenant Harry Knox, watch-officer.

Lieutenant C. P. Perkins, instructor in navigation.

Lieutenant William P. Potter, watch-officer.

Ensign W. H. H. Sutherland, watch-officer.

Ensign J. M. Roper, watch-officer.

Ensign A. M. Knight, watch-officer.

Paymaster, W. Goldsborough.

Surgeon, H. N. Beaumont.

Assistant surgeon, D. N. Bertolette.

Boatswain, Andrew Milne.

Gunner, Robert Summers.

Clerk to commandant of cadets, C. M. McLeod.

Paymaster's clerk, James Macgregor.

Mr. Rowland Gardner, of Nantucket, was employed as coast-pilot.

On June 26, we got under way and started down the bay, towed from time to time by the United States steamer *Mayflower* to expedite our passage to the capes. On the 28th of the same month we were clear of the Chesapeake, and bound to New York, where we arrived July 1. At that port the cadets were granted leave to visit the Centennial, and the ship took in stores and ammunition for the cruise.

July 8, we got under way for New Bedford, where we anchored on the 10th of the same month. From that date until your arrival, on August 21, the regular exercises of the cruise were conducted in Buzzard's Bay. A brief visit of one day at Vineyard Haven, and of three or four at Newport, made the only break until our return to the capes of Virginia, September 5.

The cadet-midshipmen were disembarked at the academy, September 18.

They were, throughout the cruise, stationed and alternated in their stations in the same manner as during the preceding summer, and as exhibited in my report of last year. The system of instruction was similar, and was conducted by the watch-officers, supervised by the executive officer and myself.

Notwithstanding the visit to New York, which caused our arrival in Buzzard's Bay to be somewhat later than the year before, the remarkable prevalence of suitable weather for our work enabled us to accomplish

more than then, and confirmed, in my mind, the eminent advantages possessed by that cruising-ground over all other available ones with which I am acquainted.

The first class of forty-seven members, in charge of the deck, performed 384 maneuvers, comprising tacking, wearing, box-hauling, chapeling, getting under way, and anchoring, an increase over work of last year of more than 100 maneuvers.

The amount of instruction in navigation, too, was quite equal to that of the preceding year, and embraced middle-latitude sailing; Mercator's sailing; course, distance, current; longitude by time-sight,  $\odot$ ; longitude by time-sights,  $\Delta$ ; latitude by meridian altitudes of  $\odot$  and  $\Delta$ ; latitude by circum-meridian altitudes; latitude by altitudes near noon and by Sumner's method; times of high water, Sumner's method; times of sunset and sunrise; amplitudes, azimuths; latitude by Chauvenet's method; variation and deviation of compass; construction of Mercator's chart; chart of Buzzard's Bay; coast chart from Buzzard's Bay to Cape Hatteras; rules in regard to buoys, entering harbor; cross-bearings for plotting position of ship; chronometer comparisons and interpolations for time; adjustment of sextant.

In the third class, the instruction in navigation was only extended to such as volunteered to receive it, and but five cadets embraced the opportunity. They were O. H. P. Belmont, A. B. Clements, E. E. Hayden, R. H. Miner, and R. S. Sloan.

As the cruise progressed the improvement in the whole bearing of the gentlemen of the first class, while handling the ship under sail, was very marked, and was a source of great satisfaction to me.

Saturdays and Sundays were habitually passed in port, and the cadets granted leave to visit the shore. Those who merited the indulgence and desired to take advantage of it were permitted, either from New Bedford or Hampton Roads, to visit their friends for a week.

The general conduct of the cadets has been good. Exceptional cases have been specially reported.

I am indebted to the officers charged with instruction for their hearty co-operation in the work, as well as to all others for a pleasant and successful cruise.

Accompanying this report I inclose, in duplicate, the cruise-standing of the cadets of the first and third classes, as determined from the marks of the several officers.

Very respectfully, your obedient servant,

EDWD. TERRY,

*Commander, United States Navy, Commandant of Cadets.*

Rear-Admiral C. R. P. RODGERS,

*Superintendent Naval Academy.*

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#### CRUISE OF THE MAYFLOWER.

U. S. PRACTICE-STEAMER MAYFLOWER, (4TH RATE,)

NAVAL ACADEMY, ANNAPOLIS, MD.,

September 18, 1876.

ADMIRAL: In obedience to your order, I respectfully submit the following report of the summer practice-cruise of this vessel under my command:

On June 21st, the twenty-eight members of the third class of cadet-

engineers reported on board for duty. They were immediately watched, quartered, stationed, messed, and berthed, and their journals and sketch-books commenced.

The plan of instruction adopted was that the cadets should land at the several ports named in your order, accompanied by the engineer-officers as instructors, the cadets on these visits to take notes of all that was seen, and rough sketches of such objects as directed by the instructors. These notes and sketches were transferred from day to day to their journals and sketch-books. Besides this, they have been instructed in the management and working of the machinery of this vessel, at all times under the immediate charge of one or both instructors.

Being in all respects ready for sea, we sailed June 26th, in company with the practice-ship *Constellation*. After having accompanied her to sea, we proceeded to the navy-yard, Norfolk, Va., arriving June 28. Here the cadets inspected the machine and boiler shops, foundery, dry-dock, pumping-engines, and the machinery of the United States steamship Alliance and Coast-Survey steamer Bache. Sailed from Norfolk, Va., July 1, arriving at the navy-yard, League Island, Pa., the following day.

The cadets visited this yard, examining the drawing of the proposed building-plans for the foundations, also inspected the sectional floating-dock and the iron-plating shop. July 3 we left the navy-yard and anchored off Philadelphia, Pa. Our visit to this port at this time was particularly intended to be made as instructive as possible to the cadets, owing to the Centennial Exhibition containing so great a collection of machinery from all parts of the world, and other objects of interest to engineering officers. The cadets were here divided into two watches, these watches visiting the Centennial Exhibition on alternate days, the watch remaining on board employed in writing up their journals and making the smooth sketches in their sketch-books of the day before. These visits continued for twelve days. During that time the most important part of the machinery-exhibit was examined by and explained to the cadets, and numbers of interesting and instructive sketches taken. They particularly examined the large shaft, with crank and couplings, forged from a solid block of crucible cast steel from the cast steel manufactory of Fred. Krupp, near Essen, Germany; large steel plates with flanges for boiler-fronts; the exhibit of large tools from William Sellers & Co., of Philadelphia, Pa., and from Whiting & Co., of Hartford, Conn.; rotary puddling-furnace from Sellers & Co., Philadelphia; the large Corliss engine, and a large gear-cutting machine from the Corliss Steam-Engine Company, of Providence, R. I., being the one used in cutting the teeth of the large wheel of the great exhibition engine; a model of a circular iron-clad, from Russia; an exhibit from the Imperial Technical School of Moscow, principally intended for the education of mechanical constructors and engineers, and technical engineers, showing by tools and models the course of practical instruction; a large collection of safety-boilers, some injectors and turbines; the exhibit of J. A. Roebling's Sons, of Trenton, N. J., of iron and steel wire rope; the Westinghouse air-brake, and manner of operating it; a variety of rotary and centrifugal pumps, piston and plunge pumps; a large variety of blowers for furnace-blasts and ventilation; and a great many other objects of great interest and value.

We next visited the establishments of William Sellers & Co., Bement & Sons, W. Cramp & Sons, J. P. Morris & Co., and Neafie & Levy, all of Philadelphia, where the cadets witnessed the manner of manufacturing the large tools, engines, boilers, and the construction of iron ships.

Having devoted as much time to Philadelphia as possible, we sailed July 23, arriving at Chester, Pa., the same day. Here the ship-yard and machine-shops of John Roach & Sons claimed our attention. Every facility was given the young gentlemen to examine the construction of the iron-clads Puritan and Miantonomoh, and an iron merchant-ship which is being built at this yard. The attention of the cadets was directed particularly to the plating, armor-backing, stern-bearing, sea-valves, water-tight compartments, manner of bending and arranging the frames, fastenings, &c., of these two large iron-clad vessels. The machine and boiler shops, the mold-loft and foundry were also visited. Left Chester July 25, and anchored at Edgemoor the same day. All the cadets were sent on shore with their instructors, and examined the large bridge-making works of Sellers & Co. From here we proceeded to Wilmington, Del., arriving July 26, and visited the ship-yard and machine-shops of the Harlan Hollingsworth Company, plate-rolling mills of Seidell & Hastings, the Diamond State Iron Company's Works, the machine-works of J. M. Pool & Co., machine-shops of Pusey, Jones & Co., and the Lobdell Car-Wheel Company's Works.

At Wilmington the cadets had the opportunity of examining the construction of the iron-clad Amphitrite, construction of engines, boilers, the manner of working the rolling-mills, casting, and operating of the puddling-furnaces. Left Wilmington July 30, and arrived at the New York navy-yard the next day. The machine and boiler shops, drawing-rooms, foundry, dry-dock, floating dry-dock, and pumping-engines were examined and the objects of interest explained to the cadets, and sketches taken. The machinery of the torpedo-boats Alarm and Intrepid and that of the Brooklyn were examined, and a lecture on the peculiar kinds of machinery in each carefully given. The iron and ship-building establishments of New York and Brooklyn were visited—the DeLamater Iron-Works, Morgan Iron-Works, Quintard Iron-Works, Continental Iron-Works, Chrome Steel-Works, Benton's Steam and Gas Pipe Works, and Niagara Steam-Pump Works. They also visited the Brooklyn water-works, to witness the working of the large pumps, and Hell Gate, to examine the work done there, and to have explained the manner in which it is proposed to place the explosives for removing the obstructions in the channel of that place. They also visited the New York tower and the Brooklyn anchorage of the East River bridge, now under construction, and had explained to them the proposed plans for carrying over the wires for and the laying up of the main cables, and the method of anchoring these cables was thoroughly explained. August 19, in obedience to your order, I left New York with this vessel for New Bedford, Mass., arriving there the next day; we found the practice-ship Constellation in port, and the following day we accompanied you in the flag-ship Constellation to Vineyard Haven; here the cadets were given liberty, and then, on August 22, we proceeded back to New Bedford.

On the next day this vessel was inspected by yourself, and on the next day we sailed for Newport, R. I., arriving the same night. Here the cadets visited the torpedo-station, having the several torpedoes, fuzes, magnetic batteries, &c., explained to them, and they also witnessed the explosion of prepared charges of nitro-glycerine, and examined the working-shops of the station. From Newport we went to Providence, R. I., leaving and arriving August 28. The establishments of the Corliss Steam-Engine Company, Providence Steam-Engine Company, American Screw Company, Providence Tool Company's Works, and the pumping-engines at Providence Hope Station were inspected by the cadets, and sketches taken of numerous objects of interest. We sailed

from Providence August 31, arriving at New London, Conn., that night here liberty was given, and we sailed the next day for Cold Spring, N. Y., arriving there September 2. The West Point Foundry was visited, where the operation of converting the XI-inch smooth-bore guns into VIII-inch rifles was carefully examined and sketches made of the different stages of construction. Here, also, was seen machinery differing from that seen in the numerous shops inspected during the cruise. From Cold Spring we went to Newburgh, N. Y., to inspect steam-engine works of Stanton & Ward and William Wright & Co. The cadets were sent from here by rail to the Greenwood iron-furnaces, where the interesting operation of roasting the iron-ores and reducing them to pig-iron was witnessed; the utilization of the slag by making from it mineral wool was also explained. Leaving Newburgh September 7, we arrived at the New York navy-yard in the evening. Our visit to the yard was for coal and other supplies. After receiving the necessary articles we sailed September 12 for the Chesapeake Bay and Annapolis, arriving here September 15, where, by your order, the cadets were landed to resume their academic studies on the morning of September 18.

We have been very kindly and courteously received by the commanders and other officers of the navy-yards, and by the proprietors and employés of the numerous private ship-yards and machine-shops, and by the directors and managers of the Centennial Exhibition. I believe the cruise has been what you intended it to be, of great value to these young gentlemen in their future studies and in their work in the service. I am glad to report that the health of all on board has been excellent, and the cadets have conducted themselves creditably, both on board ship and on shore. I cannot speak too highly of the support I have had from the officers serving with me, Lieut. Duncan Kennedy, the executive officer, Passed Assistant Engineers W. L. Nicoll and David Jones, instructors, and Passed Assistant Surgeon A. M. Moore. They have been ready and willing at all times, intelligent and zealous in the discharge of their several duties, and have, by their courteous and gentlemanly conduct, added much to the comfort and pleasure of all on board. I inclose the report of the professional aptitude and attention to duty of each cadet on board.

I am, sir, very respectfully, your obedient servant,

H. L. HOWISON,  
*Commander, Commanding.*

Rear-Admiral C. R. P. RODGERS, U. S. N.,  
*Superintendent United States Naval Academy, Annapolis, Maryland.*

### No. 3.—BUREAU OF YARDS AND DOCKS.

BUREAU OF YARDS AND DOCKS,  
NAVY DEPARTMENT,  
*Washington, D. C., November 3, 1876.*

SIR: I have the honor to submit the annual report of expenditures at the several navy-yards and stations under cognizance of this bureau, during the fiscal year ending June 30, 1876. Also estimates for improvements, repairs, general maintenance, contingent and civil establishment at the several yards and stations during the fiscal year ending June 30, 1878.

I beg leave to call your attention to the statements and recommenda-

tions of my last annual report, notably to that part of it which recommends that the New York navy-yard be preserved in its entirety, and to my opinion as to the necessity of at once commencing the building of a repairing-basin at League Island.

No appropriations for the improvement of navy-yards, with the exception of an insufficient appropriation for the dry-dock at Mare Island, and for improvements at League Island, have been made for some years, and the amounts for preservation and repairs of the valuable public buildings within the yards have been steadily decreasing. As a legitimate consequence of this unwise economy, the public works in all the navy-yards need extensive repairs, and the necessity for costly and more extended reparations will grow greater from year to year unless appropriations adequate to the thorough repairing of workshops, buildings, wharves, dry-docks, walls, &c., be promptly made. I beg to present without comment a schedule of the appropriations under the heads of "Maintenance of yards and docks," "Repairs and preservation," and "Contingent" for the past five years.

*Amounts appropriated for repairs and preservation, general maintenance, and contingent.*

Years.	Repairs and preservation.	General maintenance.	Contingent.
1872-73 .....	\$815,000 00	\$900,000 00	.....
1873-74 .....	666,260 00	860,000 00	\$40,000 00
1874-75 .....	500,000 00	760,000 00	40,000 00
1875-76 .....	500,000 00	760,000 00	40,000 00
1876-77 .....	100,000 00	440,000 00	20,000 00

I have the honor to submit herewith the bureau's estimates for improvement and repairs for the fiscal year ending June 30, 1878.

In preparing the estimates I have endeavored, to the best of my judgment, to recommend such objects only as I deem of the first importance to the welfare of the service.

#### KITTERY, ME.

The small amount allotted under appropriation "repairs and preservation" has been judiciously expended, and the most important and costly objects have received especial attention. Ship-houses, built many years ago, are becoming weak, and high winds strain the roofs, break the slates, open joints, and expose the frames to dampness and decay.

The dock-piers of wood, built in 1851, require extensive repairs. Machine-shops and store-houses have been examined, and many important repairs completed. Drains have been excavated through ledge to convey water away from machinery liable to be damaged in saw-pits. Bridges and landing-stages have been kept in repair for present use. The slating of all the buildings has been thoroughly examined and repaired. Many of these repairs have been temporary, the sum allotted having been inadequate to make satisfactory and thorough work.

There has been expended at this yard under the appropriation "repairs and preservation," during the fiscal year ending June 30, 1876:

For materials .....	\$7,223 82
For labor .....	13,322 84
Making an aggregate of .....	\$20,546 66

The amount expended under the head of "General maintenance" is:

For materials .....	\$13,407 49
For labor .....	59,548 92

Making an aggregate of .....	\$72,956 41
The amount expended under the head of "Civil establishment" is.....	5,000 93

Making a total expenditure of .....	98,504 00
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The estimates submitted by the authorities at the yard for the fiscal year ending June 30, 1878, are, for—

Repairs and preservation.....	\$58,750
General maintenance.....	85,350
Civil establishment .....	3,700

Making an aggregate of .....	147,800
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The very limited amounts allotted to this yard for repairs and preservation during the last two fiscal years, although expended to the best possible advantage, have been quite insufficient to make all the repairs actually needed. Objects of the first importance have been attended to as far as the funds would admit, but many of the minor works have necessarily been delayed for further appropriations.

#### BOSTON, MASS.

No appropriation was made for permanent improvements at this yard, and the expenditures during the fiscal year ending June 30, 1876, were confined to the necessary repairs of existing buildings, docks, wharves, roads, &c., and these have received such attention as the limited amount allotted would allow.

The amount expended under head of "Repairs and preservation" during the fiscal year is:

For materials .....	\$17,716 37
For labor .....	34,112 92

Making an aggregate of .....	\$51,829 29
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The amount expended under the head of "General maintenance" is:

For materials .....	\$29,779 60
For labor .....	85,473 23

Making an aggregate of .....	115,252 83
The amount expended under head of "Civil establishment" is.....	6,546 90

Making a total expenditure of .....	173,629 02
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The estimates submitted by the authorities of the yard for new improvements, repairs and preservation, general maintenance, and civil establishment, are, for—

New improvements.....	\$463,106 55
Repairs and preservation.....	109,000 00
General maintenance.....	141,550 00
Civil establishment .....	8,650 00

Making a total of .....	722,306 55
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There has been no special appropriation for works of improvement at this yard for several years past. Some of the objects for which estimates are submitted from the yard are regarded as very necessary for the protection of the public property, and as additions to the facilities



for performing the current work of the service. Estimates for such as are deemed of pressing necessity by the bureau are submitted in another part of this report.

## NEW LONDON, CONN.

At this yard there has been expended during the past fiscal year, under appropriation "navy-yard, New London:"

For materials.....	\$7,315 28
For labor.....	41,681 03
Making an aggregate of.....	\$48,996 31
The amount expended under head of "General maintenance," is.....	6,720 76

Making a total expenditure of..... 55,717 07

The above amount, under head of "Naval station, New London," was expended in grading the site, completing store-house, and erecting temporary buildings for stables, blacksmith's shop, and extending watch-house.

The estimates submitted by the yard authorities for the year ending June 30, 1878, are, for—

Naval station, New London.....	\$457,500
Repairs and preservation.....	3,469
General maintenance.....	26,375
Civil establishment.....	7,230

Making an aggregate of..... \$494,574

## NEW YORK, N. Y.

During the fiscal year ending June 30, 1876, there was expended at this yard, under appropriation "repairs and preservation:"

For materials.....	\$10,641 60
For labor.....	72,464 66

Making an aggregate of..... \$83,106 26

Under the head of "General maintenance," the amount expended was—

For materials.....	\$23,848 72
For labor.....	112,752 75

Making an aggregate of.....	136,601 47
The amount expended for civil establishment is.....	7,576 24

Being a total expenditure for the year of..... 227,283 97

There was no special appropriation for objects of improvement, and the expenditures upon buildings, docks, wharves, &c., have been confined to the allotment for "repairs and preservation." These expenditures have been made judiciously, and with due regard to the public interests. Repairs have been made where most needed, upon the principal buildings, docks, wharves, roads, and bridges, and a considerable amount has been expended in dredging and removing obstructions from the channels. The earth removed from the channels has been utilized in filling up low places and grading upon the flats near Washington avenue. The buildings in the yard are generally in fair condition.

The estimates submitted by the yard authorities for the fiscal year ending June 30, 1878, are, for—

New works of improvement.....	\$596,633 27
Repairs and preservation.....	134,500 00
General maintenance.....	176,350 00
Civil establishment.....	7,800 00

Making a total of..... \$915,283 27

This important yard, located at the great commercial center of the country, possesses some advantages over all others, and has many facilities for the execution of the public work; other improvements are needed to make the establishment complete, for some of which the yard authorities have submitted estimates, and from these the bureau has selected such as it deems of most pressing necessity, estimates for which will be found in an another part of this report.

#### LEAGUE ISLAND, PA.

By authority of an act of Congress the old navy-yard at Philadelphia was sold at public auction on the 2d day of December, 1875. Prior to this sale arrangements were made for the removal of all materials, stores, and other public property from the old yard to League Island. The United States steamer Antietam was fitted up as a store-ship, and all the property belonging to the United States under charge of the Bureau of Equipment and Recruiting was placed on board, and the vessel was towed to League Island, and moored in the back channel, where she now remains. A permanent store-house for Bureau of Yards and Docks having been erected at the island, all the materials and stores belonging to that bureau were transported to League Island, and properly stowed in store. No buildings having been erected for the reception of property in charge of other bureaus, temporary buildings were hastily constructed for the protection of property in charge of the Bureaus of Construction and Repair, Steam-Engineering, Ordnance, Medicine and Surgery, Navigation, and Provisions and Clothing. The large quantities of materials and stores under charge of these several bureaus were removed as expeditiously and economically as possible. The two ship-houses were taken down, transported to League Island, and re-erected; the largest as a ship-house for building purposes, the other as a store-house for Bureau of Construction and Repair.

Some other buildings were removed to League Island and re-erected, others were taken down and the materials transported to the island prior to the sale of the old yard. These old materials will be utilized in future constructions as far as available.

The amounts expended at this yard during the fiscal year ending 30th June, 1876, are, under head of "Navy-yard, League Island:—"

For materials .....	\$51,878 95	
For labor .....	125,002 45	
Making an aggregate of .....		\$176,881 40
Under the head of "Repairs and preservation:—"		
For materials .....	18,942 41	
For labor .....	96,682 75	
Making an aggregate of .....		115 625 16
Under the head of "General maintenance:—"		
For materials .....	22,577 26	
For labor .....	52,940 43	
Making an aggregate of .....		75,517 69
Under head of "Civil establishment" .....		5,245 46
And under the head of "Contingent" .....		5,234 40
Making a total of .....		378,504 11

The estimates submitted by the authorities of the yard for the fiscal year ending 30th June, 1878, are—

For works of improvement .....	\$1,760,800
For repairs and preservation .....	60,000
For general maintenance .....	64,950
For civil establishment .....	7,900

Making a total of..... 1,893,650

The civil engineer says, in submitting estimates for the large sums of money deemed necessary during the next fiscal year for the construction of the important works designed for the improvement of this navy-yard, it may be proper to briefly mention the leading principles that have governed in determining the amounts and objects of the several appropriations recommended.

The original plan, in deciding upon the abandonment of the old Philadelphia navy-yard and the selection of this island as the site for another yard, was that here should be erected a vast industrial establishment, designed upon the most extensive scale for the construction and fitting of vessels of war and the manufacture of all the appliances of naval warfare.

This original design was kept well in view by the board of civil engineers convened in 1873 to prepare the general plan for the development of a navy-yard at this point. The plan then made, and according to which all permanent improvements thus far have been built, is so arranged as to admit of the construction at first of a very small working navy yard, but one yet capable of being afterward almost indefinitely extended without altering or demolishing the works first built.

But few permanent improvements under this plan have yet been made, and the works now in progress are largely of a temporary character, intended to place the yard as soon as possible in working order, or in a condition to repair, and possibly to build, in a small way, wooden vessels for the Navy. These temporary preparations being well advanced, attention should now be given to the development of the original plan with as much rapidity as possible.

In carrying out this great design, the few permanent buildings already erected should, as soon as possible, be supplemented by other works even more expensive and difficult of construction and more important in their uses. The first and most important of these undertakings are the Delaware River quay-wall, the floating-dock basins, and ship-building ways. During the past fiscal year plans, specifications, and estimates have been prepared for the first two of these objects.

The active operations of the year in the execution of the various permanent and temporary improvements already made, and in the preparation of plans and estimates for those improvements, and for others now in progress, have left but little time for considering and designing works for future improvements. In addition to the plans named, however, plans have been prepared for a complete system of sewerage and drainage for the yard, and other designs for various yard-buildings are in progress.

From these plans, and others of a preliminary character, the foregoing estimates have been prepared; the estimates include all the works of improvement that probably can be executed during the fiscal year with advantage to the interests of the Government.

WASHINGTON, D. C.

The law making appropriations for the fiscal year ending 30th June, 1876, prohibited the expenditure at the Washington yard of any por-

tion of the amount appropriated under head of "Repairs and preservation." There was a small balance of allotment for the previous year, which was unexpended, but some works were in progress at the commencement of the fiscal year, which were continued until the remaining balance was exhausted.

The amount expended under head of "Repairs and preservation" is, for—

Materials .....	\$1,105 89	
Labor .....	695 86	
<hr/>		
Making an aggregate of.....		\$1,801 75
General maintenance, for materials.....	11,297 45	
Labor .....	52,795 80	
<hr/>		
Making an aggregate of .....		64,093 25
And for civil establishment.....		4,654 31
<hr/>		
Being a total expenditure of.....		70,549 31

The entire failure of an appropriation for repairs and preservation for the last, and the very limited amount allotted for the present fiscal year, has compelled the postponement of many repairs to the various buildings which are absolutely necessary for the protection of the public property, and consequently a larger sum will be required for the next fiscal year.

The estimates submitted by the yard authorities are—

For repairs and preservation.....	\$53,475
For general maintenance.....	75,000
For civil establishment.....	3,700
<hr/>	
Making a total of .....	132,175

This yard is well supplied with buildings and machinery, and nothing is asked for new improvements; many of the buildings require minor, and some of them extensive repairs, and the amount estimated is believed to be no more than is necessary for the proper protection of the public property.

#### NOFOLK, VA.

There was no appropriation for improvements at this yard, and the limited amount allotted under repairs and preservation has been judiciously and economically expended in making such repairs to the various buildings, docks, &c., as were indispensably necessary.

The amount expended during the fiscal year ending 30th June, 1876, under the head of "Repairs and preservation," is—

For materials.....	\$21,924 70
For labor.....	35,030 64
<hr/>	
Making an aggregate of.....	\$56,955 34

The amount expended under the head of "General maintenance" is—

For materials.....	\$18,374 88
For labor.....	69,063 26
<hr/>	
Making an aggregate of .....	87,438 14
Under the head of "Civil establishment" there was expended .....	5,051 00
<hr/>	
Making a total expenditure of.....	149,444 48

The estimates submitted by the authorities of the yard for the fiscal year ending June 30, 1878, are, for—

Works of improvement.....	\$341,209 75
Repairs and preservation.....	111,764 05
General maintenance.....	96,786 15
Civil establishment.....	7,600 00

Making a total of..... 557,359 95

This is one of the most important navy-yards, and but few appropriations for its improvement have been made for several years past; the objects for which these estimates are submitted are all important, and their construction at an early day is much desired, as they will contribute largely to the efficiency of the yard.

#### PENSACOLA, FLA.

It became necessary during the past year to erect temporary buildings for hospital purposes for the accommodation of yellow-fever patients, the old hospital-buildings having been destroyed during the war. Some temporary buildings in the yard were used for yellow-fever patients in 1874, and in consequence of their proximity to the quarters several valuable officers and men fell victims to the disease. These buildings were therefore destroyed and new buildings were erected outside of and remote from the yard. No other new works have been constructed during the past fiscal year.

The amount expended under the head of "Repairs and preservation" is—

For materials .....	\$11,907 51
For labor .....	32,612 72

Making an aggregate of..... \$44,420 23

Under the head of "General maintenance" is—

For materials .....	18,310 05
For labor .....	46,681 50

Making an aggregate of..... 64,991 55

The new hospital buildings were built under contract and charged to contingent, and cost .....	18,872 00
Amount expended under civil establishment .....	2,001 00

Making a total expenditure of..... 130,284 78

Estimates are submitted by the authorities of the yard for the fiscal year ending June 30, 1878:

For works of improvement .....	\$81,440 10
For repairs and preservation.....	98,445 91
For general maintenance .....	77,503 36
For civil establishment.....	8,500 00

Making a total of..... 265,889 37

If this yard is to be kept in active operation, the objects estimated for are very desirable and necessary; but if not, they may be deferred for future consideration.

#### MARE ISLAND, CAL.

There has been expended at this yard during the fiscal year ending June 30, 1876, for objects of improvement:

For materials .....	\$101,282 05
For labor .....	71,794 29

Making an aggregate of..... \$173 076 34

Under the head of "Repairs and preservation" there has been expended—

For materials .....	\$15,362 56
For labor .....	50,486 68
Making an aggregate of .....	\$65,849 24

Under the head of "General maintenance:"

For materials .....	24,367 70
For labor .....	80,481 94
Making an aggregate of .....	104,849 64
Under the head of "Contingent" there has been expended .....	18,411 57
Under the head of "Civil establishment" .....	6,245 93
Making in all a total of .....	368,432 72

The only works of improvement which have been in progress during the year are the excavated stone dry-dock and the iron-plating shop. The comparatively small amount appropriated for these important works has been entirely insufficient to enable the bureau to make much progress toward their completion, almost the whole of the appropriation having been expended within the first six months of the fiscal year, and the necessary suspension of work on the dry-dock is greatly to be regretted, and will cause delay in its completion and additional cost in the construction.

Estimates have been submitted by the authorities of the yard for the fiscal year ending June 30, 1878, for—

Works of improvement .....	\$1,647,085 61
Repairs and preservation .....	159,000 00
General maintenance .....	116,560 00
Civil establishment .....	9,200 00
Making a total of .....	1,931,845 61

#### SACKETT'S HARBOR, N. Y.

The expenditures of this station during the fiscal year ending 30th June, 1876, were for the proper preservation of the public property, and amounted to \$913.77.

Some of the wharves and buildings having been recently damaged by a severe storm, the sum of \$2,000 is required for the necessary repairs.

#### KEY WEST, FLA.

At this station necessary repairs have been made to the wharves and buildings, and the amount expended during the fiscal year ending 30th June, 1876, is:

For repairs and preservation .....	\$3,720 00
For general maintenance .....	2,336 04
Making an aggregate of .....	6,056 04

Estimates have been received from the authorities at the station for the fiscal year ending 30th June, 1878:

For repairs and preservation .....	\$18,639 30
For general maintenance .....	8,105 00
Making a total of .....	26,744 30

## NAVAL ASYLUM.

There were, on the 1st July, 1875, 127 persons, including officers and attendants, borne on the rolls of the asylum. During the year 24 beneficiaries have been admitted, 13 have died, 3 were dismissed, 5 left at their own request, and 2 were sent to the Government Hospital for the Insane.

During the past fiscal year proper care and attention have been devoted to the comfort and welfare of the beneficiaries, and as a general rule they conduct themselves with propriety, and appear contented and grateful for the provisions made by the Government for their support.

Cases of insubordination occur occasionally, but these are suppressed by a rigid enforcement of the regulations of the institution.

The expenses of the institution during the past year are:

For subsistence .....	\$19,474 64
For clothing, tobacco, &c .....	13,139 47
For attendants .....	7,617 05
For miscellaneous items .....	7,151 48
For repairs .....	4,685 64
For care of grounds .....	854 00
<b>Total expenditure .....</b>	<b>52,922 28</b>

Estimates have been submitted by the governor of the institution for its support during the fiscal year ending June 30, 1878, amounting to \$80,335.

No. 1.—*Report of expenditures at navy yards, stations, and Naval Asylum for fiscal year ending June 30, 1876.*

Yards and stations.	Appropriations.					Total.
	Yard improvements.	Repairs and preservation.	General maintenance.	Civil establishment.	Contingent.	
Portsmouth, N. H. ....		\$20,546 66	\$72,956 41	\$5,000 93		\$98,504 00
Boston, Mass. ....		51,829 29	115,252 83	6,546 90		173,629 02
New London, Conn. ....	\$48,996 31		6,720 76			55,717 07
New York, N. Y. ....		83,106 26	136,601 47	7,578 24		227,285 97
League Island. ....		115,625 16	75,517 69	5,245 46	\$5,234 40	378,504 11
Washington, D. C. ....		1,801 75	64,093 25	4,654 31		70,549 31
Norfolk, Va. ....		56,955 34	87,438 14	5,051 00		149,444 48
Pensacola, Fla. ....		44,490 23	64,991 55	2,001 00	18,872 00	130,354 78
Mare Island, Cal. ....		65,849 24	104,849 64	6,245 93	18,411 57	368,432 78
Sackett's Harbor. ....			913 77			913 77
Key West. ....		3,720 00	2,336 04			6,056 04
Naval Asylum. ....	52,922 28					52,922 28
<b>Total .....</b>	<b>451,876 33</b>	<b>443,853 93</b>	<b>731,671 55</b>	<b>42,321 77</b>	<b>42,517 97</b>	<b>1,712,241 55</b>

No. 2.—Detailed report from navy yards and stations of expenditures under repairs and preservation during the fiscal year ending June 30, 1878.

Objects.	Portsmouth.	Boston.	New York.	League Island.	Washington.	Norfolk.	Pennacola.	Mare Island.	Key West.	Total.
Yard-buildings.....	\$10,123 17	\$25,688 70	\$29,287 29	\$26,593 20	\$360 68	\$15,962 45	\$8,472 35	\$18,319 21	.....	\$137,807 05
Officers' quarters.....	1,855 60	2,835 75	7,930 02	10,904 72	24 39	1,724 24	19,325 50	11,673 42	.....	55,398 10
Wharves, bridges, landings, and boats.....	2,504 23	9,938 32	20,254 96	1,083 25	957 84	19,465 83	3,918 11	5,112 65	.....	63,239 19
Roads, walks, gutters, and drains.....	1,107 52	6,290 31	9,227 02	14,280 79	203 83	3,510 25	3,282 15	3,931 59	.....	34,803 46
Fences and walls.....	92 50	836 38	2,908 93	.....	174 58	2,830 26	831 44	3,151 64	.....	10,843 43
Crane, scow, and derricks.....	381 44	985 98	5,012 73	9,614 17	.....	181 20	711 88	3,258 33	.....	13,125 73
Furnaces, forges, heating-apparatus, &c.....	614 95	1,588 20	3,560 97	1,555 55	1 00	632 65	112 40	4,983 20	.....	13,359 12
Trucks and scales.....	91 00	.....	573 56	7,053 81	.....	285 63	31 70	8,692 00	.....	8,083 70
Water and gas works.....	1,540 15	3,345 82	9,485 88	9,925 84	79 73	1,491 90	61 18	2,749 86	.....	14,580 36
Dredging and scowling.....	.....	52 96	4,957 21	15,656 78	.....	3,591 53	.....	3,038 12	.....	27,963 64
Dry-dock.....	1,403 54	.....	1,554 01	1,005 13	.....	6,775 92	.....	9,449 38	.....	4,898 94
Miscellaneous repairs.....	967 56	537 57	2,999 68	28,650 86	.....	6,409 26	7,630 52	9,557 44	\$3,720 00	60,472 91
Total.....	20,546 06	51,829 29	83,106 26	115,623 16	1,801 75	56,955 34	44,420 23	65,819 24	3,720 00	443,853 93



# REPORT OF THE SECRETARY OF THE NAVY.

69

No. 3.—Detailed report of expenditures under general maintenance, received from yards and stations, during the fiscal year ending June 30, 1876.

Objects.	Portsmouth.	Boston.	New London.	New York.	League Island.	Washington.	Norfolk.	Pensacola.	Mare Island.	Sackett's Harbor.	Key West.	Total.
Freight and transportation .....	\$2 45	\$5 95	\$51 15	.....	\$81 14	.....	\$0 90	\$308 56	\$2,466 94	.....	.....	\$2,917 09
Printing, stationery, and advertising .....	545 92	874 35	147 02	\$1,372 51	1,194 47	\$343 60	1,304 29	617 08	2,513 19	.....	.....	8,912 43
Books, maps, models, and drawings .....	466 00	367 00	7 00	375 00	241 00	17 00	547 59	.....	1,739 90	.....	.....	3,650 49
Purchase and repair of fire-engines .....	429 16	898 85	13 65	4,756 28	1,198 65	921 30	2,123 43	1,456 01	1,586 39	.....	.....	11,695 72
Machinery of every description, and patent-rights .....	.....	178 78	.....	103 70	1,865 24	946 25	2,359 92	4,450 26	9,005 97	.....	.....	18,910 12
Repairs on steam-engines, and attendance on same .....	102 83	4,143 40	.....	1,777 03	8,338 17	1,134 74	2,881 19	2,594 87	4,226 58	.....	.....	25,248 81
Purchase and maintenance of oxen and horses, pay of hired teams, &c .....	13,739 47	19,267 82	253 80	16,634 75	16,807 98	4,239 94	14,639 72	8,007 20	18,619 68	.....	.....	112,212 36
Carts, timber-wheels, and tools of every description .....	2,382 79	18,063 16	550 38	3,007 01	8,394 80	1,328 77	15,418 18	5,012 71	4,743 64	.....	.....	58,901 53
Postage on letters on public service, and telegrams .....	56 16	212 89	12 50	77 45	578 96	14 69	104 77	900 00	48 95	.....	.....	2,006 37
Furniture for Government houses and offices in navy-yards .....	1,993 18	745 92	253 11	147 36	2,848 54	2,082 68	4,829 28	1,800 02	3,068 91	.....	.....	17,769 00
Coal and other fuel for yards and docks purposes .....	6,389 09	4,200 74	134 50	2,616 96	2,078 98	2,013 48	1,622 89	4,572 60	2,714 25	.....	.....	26,343 49
Candles, oil, and gas .....	2,958 66	3,966 55	40 20	5,838 25	357 62	1,377 60	2,855 44	1,935 38	7,265 22	.....	.....	26,594 92
Clearing and cleaning up yard, and care of buildings .....	4,612 71	20,815 07	1,020 73	10,919 99	3,866 92	11,886 81	8,000 88	11,274 80	3,955 27	.....	.....	76,353 18
Attendance on fires, lights, fire-engines, and apparatus .....	5,279 00	4,844 20	.....	8,606 75	5,316 71	3,681 90	5,060 83	597 32	3,308 59	.....	.....	36,655 50
Incidental labor not chargeable to other appropriations .....	10,606 81	3,393 75	1,683 05	22,962 69	7,718 27	30,369 92	9,424 59	7,863 49	18,503 38	\$913 77	\$1,244 04	103,003 99
Water-tax .....	100 00	11,270 90	40 93	6,447 29	.....	.....	45 00	195 45	2,449 95	.....	.....	20,549 52
Tolls and ferriage .....	82 08	55 42	.....	292 50	.....	.....	250 00	97 70	2,651 70	.....	.....	3,281 40
Pay of watchmen .....	23,254 32	92,883 45	2,453 32	51,162 73	14,544 50	14,323 00	15,636 12	13,682 50	16,468 66	1,092 00	.....	174,902 80
Flag, awnings, and packing-boxes .....	30 00	120 05	.....	293 02	95 63	21 57	331 12	142 40	1,532 27	.....	.....	1,651 83
Rent of housing .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,300 00
Total .....	72,956 41	115,232 83	6,720 76	136,601 47	75,517 69	61,083 25	87,438 14	64,940 55	104,849 64	913 77	2,336 04	721,620 55

No. 4.—*Estimates received from navy yards, stations, and Naval Asylum for fiscal year ending June 30, 1878.*

Yards and stations.	Appropriations.				Total.
	Yard improve-ments.	Repairs and preservation.	General main-tenance.	Civil estab-lishment.	
Portsmouth, N. H.		\$58,750 00	\$85,350 00	\$3,700 00	\$147,800 00
Boston, Mass.	\$463,106 55	109,000 00	141,550 00	8,650 00	722,306 55
New London, Conn.	457,500 00	3,469 00	26,375 00	7,230 00	494,574 00
New York, N. Y.	596,633 27	134,500 00	176,350 00	7,800 00	915,283 27
League Island, Pa.	1,760,800 00	60,000 00	64,950 00	7,900 00	1,893,650 00
Washington, D. C.		53,475 00	75,000 00	3,700 00	132,175 00
Norfolk, Va.	341,209 75	111,764 05	96,784 15	7,600 00	557,359 95
Pensacola, Fla.	81,440 10	98,445 91	77,503 36	8,500 00	265,889 37
Mare Island, Cal.	1,647,085 61	159,000 00	116,560 00	9,200 00	1,931,845 61
Sackett's Harbor, N. Y.		2,000 00			2,000 00
Key West, Fla.		18,639 30	8,105 00		26,744 30
Naval Asylum, Pa.	80,335 00				80,335 00
Total	5,428,110 28	809,043 26	868,529 51	64,280 00	7,169,963 05

No. 5.—*Detailed estimates, from navy yards and stations, for repairs and preservation for the fiscal year ending June 30, 1878.*

Objects.	Portsmouth.	Boston.	New London.	New York.	League Island.	Washington.
Yard-buildings	\$15,000 00	\$40,000 00	\$300 00	\$25,000 00	\$14,000 00	\$23,000 00
Officers' quarters	5,000 00	5,000 00	400 00	2,500 00	300 00	400 00
Wharves, bridges, landings, and boats	12,000 00	12,000 00	400 00	40,000 00	12,000 00	1,200 00
Roads, walks, gutters, and drains	6,000 00	8,500 00	544 00	10,000 00	10,000 00	175 00
Fences and walls	1,000 00	2,500 00	500 00	10,000 00	1,000 00	10,000 00
Cranes, scows, and derricks	5,000 00	3,000 00		5,000 00	3,000 00	500 00
Furnaces, forges, heating-apparatus, &c	5,000 00	5,500 00	125 00	7,500 00	1,500 00	2,000 00
Tracks and scales	250 00	5,000 00		2,000 00	2,500 00	100 00
Water and gas works	1,500 00	5,500 00		5,000 00	700 00	3,500 00
Dredging and scowage		2,500 00		15,000 00		100 00
Dry-dock	3,000 00	5,000 00		2,500 00	5,000 00	10,000 00
Miscellaneous repairs	5,000 00	8,500 00	1,000 00	10,000 00	10,000 00	2,500 00
Total	58,750 00	109,000 00	3,469 00	134,500 00	60,000 00	53,475 00

Objects.	Norfolk.	Pensacola.	Mare Island.	Sackett's Harbor.	Key West.	Total.
Yard-buildings	\$42,821 34	\$27,393 89	\$17,000 00	\$2,000 00	\$1,736 80	\$90,952 03
Officers' quarters	8,742 85	25,939 64	10,000 00			58,682 49
Wharves, bridges, landings, and boats	7,821 08	18,321 75	10,000 00		15,972 50	129,715 33
Roads, walks, gutters, and drains	15,971 16	5,858 00	8,000 00			65,044 16
Fences and walls	5,948 85	6,500 63	6,000 00			43,449 48
Cranes, scows, and derricks	7,785 43	677 00	10,000 00			34,562 43
Furnaces, forges, heating-apparatus, &c	739 80	497 00	2,000 00			24,794 80
Tracks and scales	2,083 43	1,025 00	4,000 00		930 00	17,893 43
Water and gas works	3,296 98	965 00	4,000 00			24,461 98
Dredging and scowage	10,829 87		20,000 00			54,429 87
Dry-dock	1,305 82	420 00	50,000 00			77,225 82
Miscellaneous repairs	4,419 44	10,918 00	18,000 00			70,337 44
Total	111,764 05	98,445 91	159,000 00	2,000 00	18,639 30	899,143 26

No. 6.—Detailed estimate for general maintenance, received from yards and stations, for the fiscal year ending June 30, 1878.

Object.	Portsmouth.	Boston.	New London.	New York.	League Island.	Washington.	Norfolk.	Pennacook.	Mare Island.	Key West.	Total.
Freight and transportation.....	\$100 00	\$200 00	\$100 00	\$150 00	\$100 00	\$50 00	\$300 00	\$1,000 00	\$8,000 00	.....	\$11,000 00
Printing, stationery, and advertising.....	450 00	1,200 00	400 00	2,000 00	1,000 00	1,000 00	1,000 00	1,850 00	3,500 00	.....	11,400 00
Books, maps, models, and drawings.....	150 00	1,500 00	100 00	1,000 00	250 00	50 00	700 00	100 00	4,700 00	.....	7,550 00
Purchase and repair of fire-engines.....	2,000 00	3,000 00	.....	6,000 00	1,000 00	500 00	9,992 74	2,830 00	2,000 00	.....	20,312 74
Machinery of every description, and patent rights.....	1,500 00	1,500 00	3,000 00	2,000 00	5,000 00	1,500 00	3,177 69	5,410 00	4,000 00	.....	27,087 69
10-pairs on steam-engine, and attendance on same.....	1,000 00	3,500 00	5,000 00	6,000 00	3,000 00	1,500 00	9,903 03	5,969 00	5,000 00	.....	37,872 03
Purchase and maintenance of oxen and horses, pay of hired teams, &c.....	10,000 00	30,000 00	9,000 00	30,000 00	15,000 00	7,000 00	16,437 81	6,892 00	20,000 00	.....	144,399 81
Carts, timber-wheels, and tools of every description.....	1,000 00	20,000 00	9,000 00	10,000 00	4,000 00	2,000 00	7,265 59	5,760 00	3,500 00	.....	55,523 59
Postage on letters on public service, and telegrams.....	150 00	350 00	50 00	200 00	500 00	50 00	1,00 00	1,500 00	3,500 00	.....	5,960 00
Furniture for Government houses and offices in navy yards.....	10,000 00	1,500 00	500 00	5,000 00	1,000 00	3,000 00	6,319 45	5,400 00	5,000 00	.....	37,719 45
Coal and other fuel for yards and docks purposes.....	10,000 00	8,500 00	750 00	4,000 00	1,500 00	3,000 00	2,692 28	1,000 00	7,000 00	.....	38,542 28
Candles, oil, and gas.....	3,000 00	4,000 00	100 00	6,000 00	500 00	1,600 00	2,611 50	1,797 00	9,500 00	.....	29,136 50
Cleaning and cleaning up yard and care of buildings.....	5,000 00	22,500 00	2,000 00	12,000 00	5,000 00	10,000 00	6,598 36	11,817 60	3,000 00	\$150 00	77,065 96
Attendance on fire-light, fire-engines, and apparatus.....	6,000 00	5,500 00	.....	8,000 00	7,000 00	4,000 00	6,542 90	1,941 50	3,000 00	.....	41,984 40
Incidental labor not chargeable to other appropriations.....	9,000 00	2,500 00	1,000 00	20,000 00	5,000 00	24,700 00	9,000 00	10,160 26	11,000 00	360 00	92,720 26
Water-tax.....	100 00	12,500 00	75 00	6,000 00	.....	.....	30 00	.....	5,700 00	.....	26,401 00
Tolls and ferriage.....	100 00	.....	100 00	300 00	.....	.....	300 00	150 00	3,000 00	.....	3,600 00
Pay of watchmen.....	25,000 00	24,000 00	5,500 00	55,000 00	15,000 00	15,000 00	20,425 40	14,246 00	16,000 00	1,095 00	123,066 40
Flags, awnings and packing-boxes.....	800 00	300 00	.....	700 00	100 00	50 00	389 40	430 00	600 00	.....	3,369 40
Total.....	\$5,350 00	141,550 00	28,375 00	176,350 00	84,950 00	75,000 00	96,786 15	77,503 36	116,560 00	1,605 00	862,029 51

No. 7.—Bureau's estimates for navy yards, stations, and Naval Asylum for the fiscal year ending June 30, 1876.

Yards and stations.	Appropriations.					
	Yard improve-ments.	Repairs and preservation.	General main-tenance.	Civil establish-ment.	Contingent.	Total.
Portsmouth.....		\$58,750	\$85,350	\$3,700		\$147,800
Boston.....	\$100,255	109,000	141,550	2,650		353,455
New London.....		3,469	26,375	7,230		37,074
New York.....	287,983	134,500	176,350	7,800		606,633
League Island.....	655,800	60,000	64,950	7,900		788,650
Washington.....		53,475	75,000	3,700		132,175
Norfolk.....	106,612	111,764	96,786	7,600		322,762
Pensacola.....	34,337	92,445	77,503	8,540		222,825
Mare Island.....	902,047	159,000	116,560	9,200		1,186,807
Sackett's Harbor.....		2,000				2,000
Key West.....		18,639	1,605			20,244
Naval Asylum.....	63,597					63,597
Contingent.....					\$50,000	50,000
Total.....	2,154,651	809,042	862,029	64,280	50,000	3,940,002

The aggregate amount of the estimates from the various yards and stations for improvements is very large, being \$3,347,775.28; and the bureau, after careful examination, has reduced this amount to \$2,091,054, which sum is recommended to be expended at the following yards, and for the objects named:

*At the Boston yard.*

For boundary-wall.....	\$52,434 00
For yards and docks, blacksmith-shop.....	10,552 00
For tracks and cars.....	5,000 00
For new floor to rope-walk.....	32,269 00
Total.....	100,255 00

An appropriation for the boundary-wall on the southwesterly side of the yard is regarded as most urgently required for the protection and safety of the large amount of public property stored in the vicinity. At this point the Government property is bounded by property belonging to the Fitchburgh Railroad Company, on which is stored a large quantity of coal. The present division is an old, dilapidated wooden shed and fence, affording no protection whatever against the ingress of depredators who may desire to enter the yard for plunder or for incendiary purposes. This old fence is 450 feet long, reaching to deep water, and should a fire occur there, either through accident or design, the loss to the Government might be immense.

A blacksmith-shop for the use of the Bureau of Yards and Docks is greatly needed. At present all its work is done in an old shed, very inconvenient and dangerous, and it is very desirable that all the old temporary buildings should be removed from the yard as soon as possible, as they are unsightly, inconvenient, and unsafe.

The appropriation for tracks and cars is of much importance. The cost of transporting heavy articles over common roads is very great, and the extension of these rail-tracks through the yards generally will add greatly to our facilities, and effect great economy in the expenditures for transportation.

The floor of the large rope-walk is in a wretched condition, and should

be renewed at once. In its present state the manufacture of cordage is much impeded, from frequent giving way of the floor and the time expended in necessary temporary repairs. This is the only rope-walk belonging to the Government; its machinery is good and the building should be kept in good repair.

*At the New York yard.*

For timber-shed .....	\$80,754
For timber and knee basin .....	122,732
For retaining crib-work at Washington avenue .....	84,497
<b>Total .....</b>	<b>287,983</b>

The object of first importance and necessity at this yard is an increase in the accommodations for the storage of timber and plank, large quantities of which are now in the yard, unprotected from the effects of the weather and subject to rapid decay. The loss occasioned by the deterioration of this valuable and costly material would soon equal the cost of the building, and the early construction of this shed would therefore be a matter of economy.

The accumulation of large quantities of very valuable live-oak timber, by the annual deliveries at this yard, constantly increases the necessity for a proper place for its deposit and protection from the damaging effects of exposure. This timber requires water-seasoning, and the present dock is entirely too limited in extent to receive the timber now on hand, and consequently much of it is exposed to the weather, besides occupying valuable space in the yard much needed for other purposes. It is hoped that the appropriation for extending this basin will be made.

*Retaining crib-work along boundary-line from the channel to Washington avenue.*—The length of this line is 760 feet, and borders on a slip 70 feet wide, belonging to the city of Brooklyn. The authorities of that city and the harbor-commissioners have complained, and still complain, that the alluvium from this unprotected water-front of the Government lands is constantly passing into their slip, and also into the channel, and obstructing general navigation in that quarter. It is to obviate these complaints, and to protect and improve the Government property, that an appropriation is asked for this object. It is proposed to construct a crib-work 60 feet within the Government line, by which arrangement a slip 60 feet wide will be secured, and the inside of the crib-work would form the northerly boundary of the timber-basin, and upon which timber could be landed in close proximity to the basin. The object is a very important one, and would add greatly to the protection and usefulness of that section of the yard.

*At League Island, Pennsylvania.*

For commencing quay-wall on Delaware front .....	\$137,500
For commencing floating-dock basin .....	413,300
For grading, graveling, and paving .....	95,000
For embankments .....	5,000
For temporary roads and tracks .....	5,000
<b>Total .....</b>	<b>655,800</b>

In executing the plan proposed for the development of this yard, one of the first objects of improvement will be the construction of a permanent quay-wall along the Delaware front; this will protect the yard

from inundation in that quarter, provide landing-places for materials, and berths for vessels; and the early commencement of its construction is regarded of great importance, as it is a work of great magnitude, and will require large appropriations and much time for its entire completion.

The commencement of the floating dock basin is a work that should be provided for at once, as there are no means at present by which access can be had to the bottoms of vessels requiring repairs. We have a floating-dock at the yard, but there is no place yet prepared for its use, and, unless an appropriation is made at once to secure a proper place for its operation, the dock will remain useless and subject to great deterioration.

The amount asked for grading, graveling, and paving is much needed; about twenty-nine acres have been filled in from the excavations in the back channel, and the material is of such a character as to require a covering of gravel, and the streets and avenues require paving to render them passable in wet seasons.

The small amount asked for embankments is absolutely necessary to keep them in a proper state of security. The failure of these embankments during the freshets caused the overflow of the large part of the island, which is attended with great expense and delay in the construction of the improvements authorized.

The present condition of the surface of the yard is such as to preclude the possibility of heavy hauling without the aid of rail-tracks. Quite a large amount of these tracks has been laid with great advantage and economy to the Government, and their extension and repair is indispensable for the transportation of all the large quantities of materials required in the construction of the various works of improvement.

*At Norfolk navy-yard.*

For construction of timber-shed No. 32.....	\$53,306
For construction of timber-shed No. 33.....	53,306
Total .....	106,612

The small amount of accommodations for the storage and protection of timber at this yard is a source of great loss and inconvenience. Very large quantities of costly and valuable timber have been accumulated here for future use, most of which is exposed to the weather and subject to rapid decay. This timber cannot always be readily obtained when wanted, and it is a wise policy to keep a good stock on hand, that it may be thoroughly seasoned when needed for use. These appropriations are regarded as of great importance and necessity.

*At the Pensacola navy-yard.*

For timber-shed No. 11 .....	\$32,357
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This timber-shed is much needed for the protection of timber and lumber belonging to the Bureau of Yards and Docks. This bureau has barely storage-space for the protection of a small quantity of planed lumber; all its rough timber and lumber is exposed alternately to the rays of the sun and the heavy rains, which in this climate causes rapid decay and much loss.

The cost of this building would soon be saved by a proper protection of the material from the effects of the weather, which are very damaging.

*At the navy-yard, Mare Island.*

For continuation of stone dry-dock.....	\$650,000
For removal of gas-holder and gas-works.....	6,750
For completing reservoir and water-pipes.....	37,297
For roads and pavements.....	68,000
For dredging channels.....	40,000
For commencing quay-wall and wharves.....	100,000
<b>Total .....</b>	<b>902,047</b>

In consequence of the very insufficient appropriation for the dry-dock last year, it has progressed but little beyond the mere provision of the granite of the floor, and with this exception it remains in about the same condition it was in at the date of the last annual report.

The appropriation for the present fiscal year is, in proportion to what the completion of this great and expensive work will cost, a very small one, being barely sufficient to protect the works during the year; consequently, it cannot be presumed to be much forwarded by this trifling sum. The reasons for asking for and recommending a liberal amount for carrying it vigorously on in future are very obvious. The peculiar circumstances under which a dry-dock must be built render its construction one of much risk, and therefore demand, for its avoidance as far as possible, prompt and continuous operations. The whole foundation and a very large portion of its masonry resting upon a level many feet below tide-water, require protection, while being laid, by a coffer-dam of a necessarily temporary character, the continuation of which is not calculated upon except for about the time that its use ought to be required in the uninterrupted construction of the work it is intended to secure. Its iron fastenings are exposed to the corrosive action of salt water, and thus, sooner or later, must become too weak for its safety. Other influences, of water-pressure, the action of waves, and general wear and tear in the course of time, must add their impairing effects and impose the necessity of continued repairs, the cost of which increases in proportion to the length of time such structures are maintained. If, in consequence of the want of proper appropriations, the completion of this work is delayed until this coffer-dam should so far deteriorate as to give way under the pressure imposed upon it, the consequences would be very disastrous and involve a serious loss to the Government.

It seems proper to state, as an additional reason for the speedy completion of this work, that the sectional wooden dock, on which we at present solely depend for docking vessels, cannot be relied upon much longer without very extensive repairs, if not absolute renewal. In either case the cost of such work must be great, and wisdom would seem to dictate its prevention by carrying the stone dock at once to completion for use.

With these views, the Bureau strongly urges the provision of sufficient means for pushing the work during the coming fiscal year, as far as it can be carried. If the stone for the entrance can be provided and laid and the caisson furnished, the structure can be put in a suitable state for completion the following year, provided the remaining necessary funds are then furnished.

## REMOVAL OF GAS-HOLDER AND GAS-WORKS.

The location of the stone dock, pumping house, and well, between the wings of the smithery No. 69, as recommended in the report of the

board of civil engineers, of November 19, 1873, necessitates the removal of the present gas-holder, which is situated on these premises. It is proposed to remove the whole of the gas-works to block No. 51, which by the engineers' report is assigned for such purposes. The estimate includes a convenient but temporary building, and the use of the present works, as it is believed they will serve until a more extensive and permanent establishment can be provided.

#### COMPLETING RESERVOIR AND WATER-PIPES.

These works having been already commenced and progressed to nearly the completion of the reservoir, there remains only the furnishing and laying down of the main and service pipes, and the provision of the pumping-works, to complete the system designed.

The entire absence of springs and reliable wells on this island rendered a resort to artificial means for storing the water afforded by the winter rains a necessity, as well as an economical arrangement. The cisterns in the yard will contain only about one month's supply, and after they are exhausted we are dependent upon outside sources, which are expensive and uncertain.

The appropriation for this object is regarded as of great importance, both on account of economy and safety. Should fire occur in the yard, we must depend entirely on our own fire-department, which is quite limited, as no aid could be obtained from outside, and the result would probably be very disastrous to the Government.

#### ROADS AND PAVEMENTS.

The want of good roads as well as an adequate water-supply has long been severely felt at this yard, and no improvements are more needed than these; without them all others lose a great part of their efficiency. In wet weather, owing to the natural quality of the soil whereon the yard-routes of travel lie, they become almost impassable to teams, and many important points are inaccessible, owing to the prevalence of deep mud. This appropriation is one of great importance and necessity, and is strongly urged by the bureau.

#### DREDGING AND SCOWING.

For maintaining a proper depth of water in the vicinity of the wharves and at the landings, the operation of dredging is indispensable; its efficiency and economy, however, may be greatly increased by the adoption of some system that will utilize the excavated material by depositing it upon the tule-lands belonging to the island, instead of towing it several miles and dumping it overboard, to be again deposited in the channel. With the view of providing suitable machinery and apparatus to secure this desirable end, the bureau submits this estimate and urges the appropriation.

#### COMMENCING QUAY-WALL AND WHARVES.

The location and system of quay-walls as recommended by the board of civil engineers ought to be at once undertaken, not only for the purpose of supplying the necessities of the national shipping, but for the maintenance of the yard water-front and its proper channel. An improvement of this kind must be considered fundamental for the essential purposes of a navy-yard, and should be undertaken in the early stages of its development and continued until a reasonable



provision is made to meet the demands which are likely to arise in the future. The present irregular water-front causes eddies and deposits, and this renders the almost constant use of dredging machines a necessity. With a straight line of quay-wall, presenting no obstructions to the natural currents of the river, as is now proposed, it is confidently believed that the currents sweeping along this uninterrupted line will scour the bottom and give a line of wharfage accessible at all times.

This is one of the most important objects for which appropriations are asked. It is a work of great magnitude, will require several years for its entire completion, and should be commenced as soon as possible.

#### REPAIRS AND PRESERVATION.

The amounts submitted under this head—\$809,042—are those which have been furnished from the various yards and stations, and are believed to be no more than are necessary for the proper care and preservation of the large amount of public property committed to the charge of this bureau. For several years past, and especially for the present fiscal year, the appropriations have not been sufficient to meet all the demands upon them, and consequently some of the large and expensive buildings have suffered for want of timely repairs.

#### GENERAL MAINTENANCE.

The amounts submitted under this head—\$862,029—are in accordance with the estimates furnished from the different yards and stations. They are based upon past experience of the demands under the numerous items of expenditure. And though considerably larger than the appropriation for the present fiscal year, which was unusually small, they are not larger than the appropriations under this head in former years. The pay of watchmen at the several yards is an unavoidable expense, and amounts to nearly one-fourth the appropriation asked for. Other necessary expenses, such as purchase and maintenance of teams, carts, &c., timber-wheels, coal, and other fuel, candles, oil, and gas, cleaning and clearing up yards, attendance on fires, fire engines and apparatus, and water-tax, amount to a large sum, which cannot be curtailed without detriment to the public interests.

#### CIVIL ESTABLISHMENT.

The estimates for this branch of the service—\$64,280—are believed to be no larger than necessary to secure the services of proper and efficient persons to perform the important duties imposed upon them. Many of these duties are arduous, and require for their proper discharge men of ability, intelligence, industry, and integrity.

#### CONTINGENT.

This fund is to defray the expense of any unforeseen casualty which may occur during the fiscal year, and its expenditure is carefully guarded. The amount—\$50,000—is small, and will not be used unless demanded by actual necessity.

#### NAVAL ASYLUM.

The amount estimated for this institution for pay of attendants, support of beneficiaries, and necessary repairs of buildings, furniture, fur-

naces and grates, cemetery, and care of public grounds is \$63,597, which amount is by law paid out of Navy pension fund.

Accompanying this report is an abstract of offers for supplies received for furnishing articles coming under the cognizance of the Bureau of Yards and Docks, made in conformity to the act of Congress approved March 3, 1843.

The following estimates for the fiscal year ending June 30, 1878, are respectfully submitted:

Sheet No. 1. For support of Bureau Yards and Docks.....	\$16,480
Sheet No. 2. For general maintenance of yards and stations, and for contingent.....	912,029
Sheet No. 3. For support of Naval Asylum.....	63,597
Sheet No. 4. For repairs and preservation .....	809,042
Sheet No. 5. For improvements at navy-yards.....	2,091,054
For civil establishment.....	64,280

Total estimates for Bureau Yards and Docks..... 3,956,482

I am, sir, very respectfully, your obedient servant,

J. C. HOWELL,  
Chief of Bureau.

HON. GEORGE M. ROBESON,  
Secretary of the Navy.

*Estimates of appropriations required for the service of the fiscal year ending June 30, 1878,  
by the Bureau of Yards and Docks, Navy Department.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be re- quired for each detailed object of expenditure.	Amount appropri- ated for the cur- rent fiscal year ending June 30, 1877.
<b>SALARIES.</b>		
Civil engineer, per act of March 3, 1863 .....	\$3,000	.....
Chief clerk, per act of July 5, 1862 .....	1,800	\$1,800
Draughtsman and clerk, per act of March 2, 1867 .....	1,800	1,800
One clerk of class four, per act of March 2, 1867 .....	1,800	1,800
Two clerks of class three, per act of March 2, 1867 .....	3,200	3,200
One clerk of class two, per act of March 2, 1867 .....	1,400	1,400
One clerk of class one, per act of March 2, 1867 .....	1,200	1,200
One messenger, per acts of July 5, 1862, and July 12, 1870 .....	840	840
Two laborers, at \$720 each, per acts of July 5, 1862, and July 12, 1870 .....	1,440	1,440
	16,480	13,480
<b>CONTINGENT EXPENSES.</b>		
Stationery, books, plans, drawings, incidental labor, and miscellaneous items .....	1,800	800
<b>FOR GENERAL MAINTENANCE OF YARDS AND DOCKS.</b>		
For general maintenance of yards and docks, freights, and transportation of ma- terials and stores; printing, stationery, and advertising, including command- ant's office; books, maps, models, and drawings; purchase and repair of fire- engines; machinery, and patent-right to use the same; repairs of steam-engines and attendance on the same; purchase and maintenance of oxen, horses, and driving-teams; carts and timber-wheels for navy-yard purposes; tools and re- pairs of the same; postage on letters and other mailable matter on public ser- vice, and telegrams; furniture for Government houses and offices in navy-yards; coal and other fuel; candles, oil, and gas; cleaning and clearing up yards, and care of public buildings; attendance on fires, lights, fire-engines and apparatus; incidental labor at navy-yards; water-tax; tolls and ferriages; pay of watch- men in navy-yards; awnings and packing-boxes for yards and docks purposes ..	862,029	440,000

*Estimates of appropriations required for the service, &c.—Continued.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>CONTINGENT.</b>		
For contingent expenses that may arise at navy-yards and stations .....	\$50,000	\$20,000
<b>NAVAL ASYLUM, PHILADELPHIA, PA.</b>		
Superintendent .....	600	
Steward .....	480	
Matron .....	360	
Cook .....	240	
Assistant cook .....	168	
Chief laundress .....	192	
Three laundresses, at \$168 each .....	504	
Eight scrubbers and waiters, at \$168 each .....	1,344	
Six laborers, at \$240 each .....	1,440	
Stable-keeper and driver .....	360	
Master-at-arms .....	480	
Corporal .....	300	
Barber .....	360	
Carpenter .....	845	
	<b>7,673</b>	<b>7,673</b>
For water-rent and gas .....	1,975	
For cemetery, head-stones, digging graves, &c .....	350	
For repairs of buildings and improving grounds, grates, &c .....	7,325	
For ice and car-tickets .....	450	
For furniture and repairs of same .....	500	
For support of beneficiaries .....	45,324	
	<b>55,924</b>	<b>50,504</b>
	<b>63,597</b>	<b>58,177</b>
<b>NOTE.—The expenses of the Naval Asylum to be paid from income of the "Navy pension fund," in compliance with provisions of act of March 1, 1869, (15 Statutes, 277.)</b>		
<b>NAVY-YARD, BOSTON, MASS.</b>		
For boundary-wall .....	52,434	
For yards and docks' blacksmith-shop .....	10,552	
For tracks and cars .....	5,000	
For new floor to rope-walk .....	32,269	
	<b>100,255</b>	
<b>NAVY-YARD, NEW YORK.</b>		
For timber-shed .....	80,754	
For timber and knee basin .....	122,752	
For retaining crib-work at Washington avenue .....	84,497	
	<b>287,983</b>	
<b>NAVY-YARD, LEAGUE ISLAND, PA.</b>		
For commencing quay-wall on Delaware front .....	137,500	
For commencing dry-dock basin .....	413,300	
For grading, gravelling, and paving .....	95,000	
For embankments .....	5,000	
For temporary roads and tracks .....	5,000	
	<b>655,800</b>	
<b>NAVY-YARD, NORFOLK, VA.</b>		
For timber-shed No. 32 .....	53,306	
For timber-shed No. 33 .....	53,306	
	<b>106,612</b>	
<b>NAVY-YARD, PENSACOLA, FLA.</b>		
For timber-shed No. 11 .....	32,357	

*Estimates of appropriations required for the service, &c.—Continued.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
NAVY-YARD, MARK ISLAND, CAL.		
For continuation of stone dry-dock.....	\$650,000	\$50,000
For removal of gas-holder and gas-works.....	6,750	.....
For completing reservoir and water-pipes.....	37,297	.....
For roads and pavements.....	68,000	.....
For dredging and scowling.....	40,000	.....
For quay-wall and wharves.....	100,000	.....
	902,047	50,000
	2,091,054	50,000
NAVY-YARD, PORTSMOUTH, N. H.		
Repairs and preservation at navy-yard.....	58,750	.....
NAVY-YARD, BOSTON, MASS.		
Repairs and preservation at navy-yard.....	109,000	.....
NAVAL STATION, NEW LONDON, CONN.		
Repairs and preservation at navy-yard.....	3,469	.....
NAVY-YARD, NEW YORK, N. Y.		
Repairs and preservation at navy-yard.....	134,500	.....
NAVY-YARD, LEAGUE ISLAND, PA.		
Repairs and preservation at navy-yard.....	60,000	.....
NAVY-YARD, WASHINGTON, D. C.		
Repairs and preservation at navy-yard.....	53,475	.....
NAVY-YARD, NORFOLK, VA.		
Repairs and preservation at navy-yard.....	111,674	.....
NAVY-YARD, PENSACOLA, FLA.		
Repairs and preservation at navy-yard.....	98,445	.....
NAVY-YARD, MARE ISLAND, CAL.		
Repairs and preservation at navy-yard.....	159,000	.....
NAVAL STATION, SACKETT'S HARBOR, N. Y.		
Repairs and preservation at navy-yard.....	2,000	.....
NAVAL STATION, KEY WEST, FLA.		
Repairs and preservation at navy-yard.....	18,639	.....
	809,042	100,000

**ABSTRACT OF OFFERS FOR SUPPLIES RECEIVED FOR FURNISHING ARTICLES COMING UNDER THE COGNIZANCE OF THE BUREAU OF YARDS AND DOCKS, MADE IN CONFORMITY TO THE ACT OF CONGRESS APPROVED MARCH 3, 1843.**

*Offers for iron castings for United States navy-yard at League Island, Pa., under date of advertisements of July 12, 1875.*

100,000 pounds iron castings :

	Cents.
Potter & Hoffman ..... per lb..	3½
Thos. Ellis & Bro ..... per lb..	3
Royer Bros. .... per lb..	2½
Devenney, White & H. .... per lb..	2½
Wood, Dialogue & Co. .... per lb..	3½
D. S. Cresswell ..... per lb..	*2½
J. Wood, jr., & Co ..... per lb..	2½

100,000 pounds iron castings—Continued.

	Cents.
Morris, Tasker & Co. .... per lb..	3½
S. J. Cresswell, jr. .... per lb..	2½
Barrows, Savery & Co. .... per lb..	2½
W. E. Tanner & Co. .... per lb..	3½
Phila. Arch'l Iron Co. .... per lb..	2½
Conrad & Murray ..... per lb..	3½

*Offers for supplies for United States navy-yard at Mare Island, Cal., under advertisement of August 4, 1875.*

Lumber :

William Walker .....	\$6,237 72
A. Powell .....	6,473 00

Lumber—Continued.

Pope & Talbot .....	\$6,956 00
J. E. de la Montagnie ....	*5,760 00

*Offers for supplies for United States navy-yard at Mare Island, Cal., under advertisement of September 9, 1875.*

Lumber :

Jas. E. de la Montagnie ..	\$3,704 75
A. Powell .....	*3,437 50
Pope & Talbot .....	3,929 75

Lumber—Continued.

Charles Hare .....	\$4,356 00
William Walker .....	4,033 00

*Offers for supplies for United States navy-yard at Mare Island, Cal., under advertisement of September 22, 1875.*

Lumber :

Charles Hare .....	\$199 10
Pope & Talbot .....	*166 32
A. Powell .....	183 94

Lumber—Continued.

J. E. de la Montagnie .....	\$186 95
William Walker .....	176 08

**ABSTRACT OF OFFERS FOR SUPPLIES RECEIVED FOR FURNISHING ARTICLES COMING UNDER THE COGNIZANCE OF THE BUREAU OF YARDS AND DOCKS, MADE IN CONFORMITY TO THE ACT OF CONGRESS APPROVED MARCH 3, 1843.**

*Offers for causeway at the League Island navy-yard, Pennsylvania, under advertisement dated January 4, 1876.*

Austin P. Brown .....	*\$17,900
American Dredging Co. ....	21,302

J. Powell & Son .....	\$21,497
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Opened February 1, 1876, in presence of—

J. C. HOWELL, *Chief of Bureau.*  
 W. P. S. SANGER, *Civil Engineer of Bureau.*  
 A. E. MERRITT, *Chief Clerk of Bureau.*  
 FRANKLIN A. STRATTON, *Civil Engineer, League Island.*  
 D. J. PARTELO, *Clerk Bureau Yards and Docks.*

\*Accepted.

*Offers for supplies for United States navy-yard at League Island, Pa., under advertisement of August 3, 1876, for lumber, rope, oil, &c.*

## Lot No. 1. Lumber:

S. G. M. Maule .....	\$1,300 00
S. P. Brown .....	1,310 00
William L. Loyd & Co. ....	1,450 00
J. W. Gaskill & Sons .....	*1,047 50
Benton & Bro .....	1,390 00

## Lot No. 2. Rope:

Paul J. Field .....	\$254 97
Uhler, English & Boileau ..	235 20
John T. Bailey & Co. ....	232 26
Hammill & Stubs .....	*230 51
E. H. Fitler & Co. ....	234 48
Darrah & Elwell .....	254 72

## Lot No. 3. Oil:

Paul J. Field .....	\$85 60
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## Lot No. 3. Oil—Continued.

Darrah & Elwell .....	*\$82 89
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## Lot No. 4. Lumber:

S. G. M. Maule .....	\$680 00
S. P. Brown .....	*514 00
J. W. Gaskill & Sons .....	541 75
William L. Loyd & Co. ....	725 50
Benton & Bro .....	568 00

## Lot No. 5. Lumber:

S. G. M. Maule .....	\$577 50
S. P. Brown .....	*420 00
J. W. Gaskill & Sons .....	472 00
William M. Loyd & Co .....	551 25
Benton & Bro .....	478 50

*Offers for two hundred tons Lehigh coal for League Island navy-yard, under advertisement of August 23, 1876.*

## Bidders:

Per ton.

Lehigh & Wilkesbarre Coal Co. \$4 35
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## Bidders—Continued.

Per ton.

Campbell Tucker & Co .....	*\$4 23
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*Offers for supplies for the United States navy-yard, New York, under advertisement dated August 24, 1876.*

## Class No. 27. 350 tons anthracite coal, for steam-boilers:

	Per ton.
Samuel G. French .....	†\$3 17
D. Babcock & Co .....	3 25
W. Merritt .....	3 80
J. H. Redfield .....	3 95
James D. Leary .....	4 14

## Class No. 27. 80 tons anthracite coal, stove-size:

Samuel G. French .....	†\$3 90
D. Babcock & Co .....	3 97
W. Merritt .....	4 35

## Class No. 27. 80 tons anthracite coal, stove-size—Continued.

	Per ton.
J. H. Redfield .....	\$4 50
James D. Leary .....	4 74

## Class No. 27. 50 tons anthracite coal, egg-size:

Samuel G. French .....	†\$3 70
D. Babcock .....	3 35
W. Merritt .....	3 70
J. H. Redfield .....	4 20
James D. Leary .....	4 14

\*Accepted.

†Accepted, being the lowest in the aggregate.

*Offers for supplies for the Naval Asylum, Philadelphia, Pa., under advertisement dated August 29, 1876.*

## Class No. 1. Clothing :

Wannamaker & Brown ..	*\$5,204 00
Jacob Reed .....	5,283 60

## Class No. 2. Boots and shoes :

James Cotter & Sons ....	\$2,181 25
Wannamaker & Brown...	2,253 75
W. McKnight.....	*2,062 50

## Class No. 3. Provisions :

Gibbons & Wallace.....	\$10,142 00
William Godfrey.....	10,210 50
Gotlieb Scheidt.....	9,689 90
Harry H. Corney.....	10,345 60
John Brenn.....	*9,429 20

## Class No. 4. Groceries :

Hill & Brother .....	\$7,149 54
Anderson & Dunlap .....	7,469 10
Robert McKeown.....	*6,914 70

## Class No. 5. Dry goods :

George Milliken .....	*\$545 75
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## Class No. 6. Bread :

George C. Ellenger.....	\$2,075 00
John McIlwain .....	1,630 00
Gordon Nealis .....	1,509 00
James Park .....	*1,408 25

## Class No. 7. Tobacco :

J. Rinalde Sauk & Co.....	*\$1,104 00
Paul J. Field .....	1,127 00

## Class No. 8. Coal and wood :

William F. Moody .....	*\$1,718 50
Robert Murray Chaton....	1,997 50
Campbell, Tucker & Co...	1,842 00

## Class No. 9. Paints, oils, &amp;c. :

J. B. Shannon.....	*\$636 42
Bellah & Elliott .....	649 92
William Waterall & Co...	†611 37

## Class No. 11. Lumber :

S. G. M. Maule.....	\$796 75
J. W. Gaskill & Sons .....	*655 15

## Class No. 13. Provender :

Paul J. Field .....	*\$198 60
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## Class No. 14. Miscellaneous :

J. B. Shannon.....	*\$380 95
Paul J. Field.....	7,819 85

## Class No. 15. Hardware :

J. B. Shannon.....	\$285 58
Paul J. Field .....	*282 58
Bellah & Elliott.....	293 52

We certify that the above proposals were opened in our presence ; that the scale is correct ; and the contracts have been awarded to the lowest bidders, according to the advertisements.

BUREAU OF YARDS AND DOCKS, *September 26, 1876.*

J. C. HOWELL, *Chief of Bureau.*  
W. P. S. SANGER, *Civil Engineer of Bureau.*  
A. E. MERRITT, *Chief Clerk of Bureau.*  
R. H. YEATMAN, *Clerk Class 3.*

*Offers for supplies for the United States navy-yard, New York, under advertisement dated September 2, 1876.*

## Class No. 20. Hay :

E. R. Shipman.....	*\$1,232 00
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## Class No. 20. Hay—Contin'd.

J. H. Redfield .....	\$1,247 50
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*Offers for supplies for the United States navy-yard, League Island, Pa., under advertisement dated September 2, 1876.*

## Class No. 1. Stationery :

William H. Dempsey.....	*\$570 79
R. Magee & Sons .....	747 40
James W. Queen & Co....	852 77
Walstrun & Stevens.....	704 67

## Class No. 2. Drawing materials :

W. H. Dempsey.....	*\$241 80
James W. Queen & Co...	297 25

\* Accepted.

† Received too late.

*Offers for material and labor for storehouse, extension of main wharf, storage and mold-loft building, furnishing and driving piles for saw-mill and wharf, at the navy-yard, League Island, under advertisements dated September 7, 1876.*

**For steam-engineering storehouse:**

Nathaniel McKay.....	\$14,938 00
Austin P. Brown.....	24,891 00
S. H. & J. H. Adams.....	14,835 00
Philip Quigley & Son.....	*13,300 00
Peters & Burger.....	24,720 00
J. M. Mays & Co.....	19,986 00
William W. Upp.....	17,990 00

**For extension of main wharf:**

Austin P. Brown.....	\$18,699 00
J. M. Mays & Co.....	*17,167 00
American Dredging Co....	19,913 90
William W. Taxis.....	31,934 00
James L. Atkinson.....	25,484 83

**For storage and mold-loft building:**

Hiram Miller.....	\$29,313 00
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**For storage and mold-loft building—Continued.**

John Crump.....	\$12,576 00
Nathaniel McKay.....	13,486 00
Austin P. Brown.....	26,991 00
S. H. & J. H. Adams.....	13,264 00
Philip Quigley & Son.....	*12,500 00
Peters & Burger.....	18,000 00
William W. Upp.....	13,425 00

**For furnishing and driving piles for saw-mill, and furnishing all materials and labor for wharf:**

Austin P. Brown.....	*\$9,573 00
American Dredging Co....	9,783 12
William W. Taxis.....	†5,492 60
James Westcott & Son....	†9,450 00
James L. Atkinson.....	9,672 00

We certify that the above proposals were opened in our presence, that the scale is correct, and that the contracts have been awarded to the lowest bidders according to the advertisements.

J. C. HOWELL,  
Chief of Bureau.

W. P. S. SANGER,  
Civil Engineer, Bureau Yards and Docks.

A. E. MERRITT,  
Chief Clerk of Bureau.

D. J. PARTELLO,  
Clerk of Class 4.

BUREAU OF YARDS AND DOCKS, September 30, 1876.

*Offers for supplies for the United States navy-yard, Washington, D. C., under advertisement dated September 13, 1876.*

**Class No. 20. Provender:**

Frank Dorsey.....	*\$1,312 48
C. T. Yoder.....	1,717 50
Barbour & Hamilton.....	1,535 25
Jos. L. Savage.....	\$1,105 50

**Class No. 23. Hose:**

D. Babcock.....	\$1,372 70
Walton Brothers.....	1,596 00
J. D. Cummings.....	*1,356 00

**Class No. 23. Hose—Continued.**

T. M. Shepherd.....	\$1,569 25
Joseph L. Savage.....	†1,587 10

**Class No. 29. Bituminous (Cumberland) coal:**

T. W. Riley & Sons.....	*\$857 50
Johnson Brothers.....	922 50
T. E. Clark & Co.....	885 00
C. T. Yoder.....	867 50
Joseph L. Savage.....	972 50
A. Greenlees, jr.....	910 00

\* Accepted.

† Declined.

; For wharf only.

§ Informal.



*Offers for plowing, sowing, harrowing, and rolling about 300 acres of land on Mare Island, Cal., under advertisement dated September 18, 1876.*

Name of bidder.	Plowing dry, per acre.	Plowing after rain, per acre.	Hauling and spreading manure per load.
George Rounds.....	\$6 00	\$4 75	\$0 50
W. E. King.....	4 00		135 00
J. Driscoll.....	3 75		25
G. Fitzmaurice.....	3 25		10
John O'Neal and James Costello.....	*2 95		20

*Offers for supplies for the United States navy-yard, League Island, Pa., under advertisement dated September 18, 1876.*

## Class No. 5. Oak and hard wood:

A. Benton & Brother.....	\$347 50
J. W. Gaskill & Son.....	*300 00

## Class No. 6. White pine, &amp;c.:

A. Benton & Brother.....	\$384 00
J. W. Gaskill & Son.....	*317 00

## Class No. 7. Lime:

Cedar Hollow Lime Co....	\$63 00
Paul J. Field.....	† 63 00

## Class No. 8. Cement:

Lesley & Trinkle.....	\$329 00
Paul J. Field.....	*475 50

## Class No. 9. Gravel and sand:

Paul J. Field.....	*\$111 00
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## Class No. 11. Iron spikes and

Bellah & Elliott.....	*\$125 00
Paul J. Field.....	142 00

## Class No. 12. Steel:

Midvale Steel Works.....	*\$46 75
Noblitt, Brown, N., & Co..	55 00
Paul J. Field.....	59 00

## Class No. 14. Files:

Bellah & Elliott.....	\$90 88
Noblitt, Brown, N., & Co..	109 45
Paul J. Field.....	*81 50

## Class No. 15. Paints, oils, and glass:

Bellah & Elliott.....	\$231 20
W. Waterall & Co.....	*221 50
Noblitt, Brown, N., & Co..	234 45

## Class No. 16. Ship-chandlery:

Noblitt, Brown, N., & Co..	*\$396 35
Paul J. Field.....	431 15

## Class No. 17. Hardware:

Bellah & Elliott.....	\$944 26
Noblitt, Brown, N., & Co..	874 46
Paul J. Field.....	*823 85

## Class No. 20. Hay:

Paul J. Field.....	*\$788 00
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## Class No. 21. Provender:

Paul J. Field.....	*\$468 00
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## Class No. 22. Charcoal:

Paul J. Field.....	*\$17 50
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## Class No. 24. Oils:

Noblitt, Brown, N., & Co..	*\$211 00
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## Class No. 25. Iron-work, piping, &amp;c.:

Paul J. Field.....	*\$52 50
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## Class No. 27. Anthracite coal:

No bids received.

## Class No. 29. Bituminous Cumberland coal:

No bids received.

## Class No. 32. Machinery and tools:

J. A. Fay & Co.....	*\$1,334 00
Paul J. Field.....	1,840 00

\* Accepted.

† Incomplete.

‡ Decided by lot.

\$ Per lot.

*Offers for supplies for the United States navy-yard, Mare Island, Cal., under advertisement dated September 21, 1876.*

## Class No. 5. Lumber :

William Walker.....	\$919 75
A. Powell .....	†870 00

## Class No. 11. Nails :

William Walker.....	\$72 45
A. Powell .....	*77 00

*Offers for supplies for the United States navy-yard, Norfolk, Va., under advertisement dated September 23, 1876.*

## Class No. 4. Yellow pine :

A. A. McCullough.....	*\$750 00
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## Class No. 11. Round iron, &amp;c. :

E. V. White & Co.....	\$41 10
Holmes & Co.....	43 50
Taylor, Elliott & Waters..	47 40
Forbes & Butts.....	*39 90

## Class No. 5. Walnut :

A. A. McCullough.....	*\$44 00
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## Class No. 11. Iron spikes, nails, &amp;c. :

E. V. White & Co.....	*\$26 75
Holmes & Co.....	32 75
Taylor, Elliott & Waters	37 50
Forbes & Butt.....	30 25
D. K. Osbourn .....	83 56

## Class No. 14. Files :

E. V. White & Co.....	\$39 99
Holmes & Co.....	47 15
Taylor, Elliott & Walters	49 75
Forbes & Butt.....	*36 85
D. K. Osbourn .....	52 54

## Class No. 16. Cotton-waste, &amp;c. :

E. V. White & Co.....	*\$12 40
Holmes & Co.....	15 00
Taylor, Elliott & Waters	16 50
Forbes & Butts.....	12 95
D. K. Osbourn.....	27 25

## Class No. 17. Hardware, &amp;c. :

E. V. White & Co.....	\$19 65
Holmes & Co.....	*18 35
Taylor, Elliott & Waters	27 80
Forbes & Butts.....	19 65
D. K. Osbourn .....	46 13

## Class No. 18. Stationery :

Vickery & Co.....	\$525 24
D. K. Osbourn .....	*406 35
W. H. Dempsey.....	449 20

## Class No. 20. Hay, &amp;c. :

Peters Bros.....	*\$302 25
A. A. McCullough.....	360 00

## Class No. 21. Provender :

A. A. McCullough.....	*\$294 92
Peters Bros.....	329 25

## Class No. 23. Gum, Packing, &amp;c. :

E. V. White & Co.....	*\$11 00
Holmes & Co.....	12 50
Taylor, Elliott & Waters	17 50
Forbes & Butts.....	12 00
D. K. Osbourn .....	27 50

## Class No. 24. Lard oil :

E. V. White & Co.....	*\$17 00
Holmes & Co.....	18 00
Forbes & Butts.....	17 60
D. K. Osbourn.....	27 60

## Class No. 15. White lead, zinc, &amp;c. :

E. V. White & Co.....	\$30 00
Holmes & Co.....	33 00
Forbes & Butts.....	31 25
D. K. Osbourn.....	*27 00

## Class No. 17. Hardware, &amp;c. :

E. V. White & Co.....	\$42 04
Holmes & Co.....	47 14
Taylor, Elliott & Waters..	62 36
Forbes & Butts.....	*40 45
D. K. Osbourn.....	62 32

\*Accepted.

†Accepted, being the lowest in the aggregate.

*Offers for supplies for United States navy-yard at League Island, Pa., under advertisement dated October 18, 1876.*

## Class No. 1. Brick :

Benjamin Allen..... \*\$592 00

## Class No. 2. Lime :

Benjamin Allen..... \$1,140 00  
 Paul J. Field..... 1,170 00  
 Morris & Budd..... \*1,050 00  
 Cedar Hollow Lime Co... 1,188 00

## Class No. 3. Hydraulic cement :

Benjamin Allen..... \*\$244 00  
 Lesley & Trimble..... 290 00  
 Paul J. Field..... 398 00  
 Morris & Budd..... 600 00  
 David Babcock & Co.... 308 00  
 J. G. & J. M. Waters.... 318 00  
 S. M. Hamilton..... 380 00

## Class No. 4. Building-sand :

Benjamin Allen..... \*\$414 00  
 Paul J. Field..... 534 00  
 Abel Jeanes..... 1,020 00

## Class No. 5. Cast-iron columns, plate-iron girders, and iron I-beams :

David Babcock & Co.... \$20,492 80  
 Potter & Hoffman..... 21,395 00  
 H. A. Ramsey..... 21,742 30  
 William B. Scaife & Sons 19,584 50  
 Phoenix Iron Company.. \*17,772 50  
 Philadelphia Arch Iron Company..... 20,403 00  
 Edgemore Iron Company 18,096 60  
 New Jersey Steel and Iron Company..... 19,432 30

Opened in the presence of—

J. C. HOWELL,

*Chief of Bureau.*

W. P. S. SANGER,

*Civil Engineer, Bureau Yards and Docks.*

A. E. MERRITT,

*Chief Clerk Bureau.*

D. J. PARTELLO,

*Clerk Class 4.*

*Offers for supplies for United States navy-yard at League Island, Pa., on requisitions Nos. 56, 57, and 58, October 25, 1876.*

## Requisition No. 56. Spikes, &amp;c.:

Paul J. Field..... \$238 00  
 Noblit, Brown, N., & Co. †199 76  
 J. B. Shannon..... \*234 70

## Requisition No. 57. Window-glass, &amp;c.:

B. H. Shoemaker,  
 in part, glass... \$40 00  
 Robert Shoemaker  
 & Co., in part.. 99 50  
 \$139 50

## Requisition No. 57. Window-glass, &amp;c.—Continued.

Noblit Brown, N., & Co.. \$142 88  
 Russell & Landis..... 138 85  
 W. F. Simes & Son..... 124 00  
 U. S. Lead Co..... \*123 85

## Requisition No. 58. Spikes, &amp;c.:

Paul J. Field..... \*\$133 25  
 Noblit Brown, N., & Co.,  
 (wrought bolts)..... 161 11  
 J. B. Shannon..... 137 25

\*Accepted.

†Incomplete.

*Offers for supplies for United States navy-yard at League Island, Pa., on requisitions Nos. 50, 51, 52, 53, 54, and 55, October 25, 1876.*

**Requisition No. 50. Hinges, &c.:**

Paul J. Field.....	\$115 00
Noblit, Brown & Co.....	139 36
J. B. Shannon.....	*114 40

**Requisition No. 51. Japan drier, &c.:**

W. F. Simes & Son.....	\$110 35
Paul J. Field.....	72 10
Noblit, Brown, N., & Co.	†72 10

**Requisition No. 52. White zinc in oil:**

W. F. Simes & Son.....	\$50 00
Noblit, Brown, N., & Co.	55 00
Russell & Landis.....	51 25
Felton, Ran & Sibley....	*47 50
United States White-Lead Company.....	48 12

**Requisition No. 53. Window-glass, &c.:**

W. F. Simes & Son.....	\$291 80
Noblit, Brown, N., & Co.	319 35

**Requisition No. 53. Window-glass, &c.—Continued.**

Russell & Landis.....	\$312 50
Felton, Ran & Sibley....	291 35
United States White-Lead Company.....	*283 20

**Requisition No. 54. Gouges, &c.:**

Paul J. Field.....	\$68 05
Noblit, Brown, N., & Co.	62 60
J. B. Shannon.....	*60 93

**Requisition No. 55. Window-glass, &c.:**

Noblit, Brown, N., & Co.	\$265 03
Russell & Landis.....	259 85
Felton, Ran & Sibley....	243 40
Benj'n H. Shoemaker, in part only, glass....	\$155 00
Robert Shoemaker & Co., in part only.....	94 10
	249 10
United States White-Lead Company.....	*237 42

*Offers of supplies for the United States navy-yard at Mare Island, Cal., under advertisement dated October 31, 1876.*

**Requisition No. 24. Gasoline and plow:**

F. B. Taylor & Co.....	*\$383 50
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**Requisition No. 25. Upholstering materials:**

Coffin & Hendry.....	*\$315 65
James E. Gordon.....	317 05

**Requisition No. 26. Lumber:**

A. Powell.....	*\$327 50
William Walker.....	351 50

**Requisition No. 27. Hardware:**

James E. Gordon.....	*\$244 50
W. M. Rockwell.....	311 79
Coffin & Hendry.....	313 32
Dunham, Carrigues & Co.	462 15

**Requisition No. 28. Miscellaneous:**

James E. Gordon.....	*\$145 00
Coffin & Hendry.....	158 00

**Requisition No. 29. Stone and gravel:**

A. Powell.....	†\$812 50
Thomas Rodgers.....	812 50

**Requisition No. 30. Hardware:**

James E. Gordon.....	*\$448 00
W. M. Rockwell.....	546 62
Coffin & Hendry.....	532 72
Dunham, Carrigues & Co.	715 50

**Requisition No. 31. Hardware:**

James E. Gordon.....	\$589 75
Coffin & Hendry.....	*523 63
W. M. Rockwell.....	603 95
Dunham Carrigues & Co.	796 50

**Requisition No. 32. Iron:**

James E. Gordon.....	*\$98 50
W. M. Rockwell.....	113 50
Coffin & Hendry.....	134 00
Dunham, Carrigues & Co.	150 00

\*Accepted.

†Decided by lot.

‡Informal.

*Offers for supplies for United States navy-yard at Portsmouth, N. H., under advertisement dated November 6, 1876.*

Hay, per ton :		C. W. Cottle.....	\$15 00
George H. Hayes.....	*\$17 69	G. A. Hammond.....	18 00
Lewis & Brooks.....	20 00	Corn-meal, per bushel :	
C. W. Cottle.....	19 00	Lewis & Brooks.....	*73½
G. H. Hammond.....	20 00	Hill & Stover.....	97½
Straw, per ton :		Geo. Getchel.....	84
Lewis & Brooks.....	20 00	C. W. Cottle.....	80
Steven Grant.....	*11 50	I. Brooks.....	74
		Thomas Neal.....	74

*Offers for supplies for United States navy-yard at League Island, Pa., under advertisement dated November 10, 1876, on requisitions Nos. 62, 63, 64, and 65.*

Requisition No. 62. White-lead, &c. :		Requisition No. 64. Pipe, brackets, &c. :	
United States White-Lead Company.....	*\$130 60	S. J. Creswell.....	\$329 14
Felton, Ran & Sibley...	131 80	Noblit, Brown, N., & Co.	322 52
Requisition No. 63. Wrought-iron pipes, &c. :		J. B. Shannon.....	*314 14
Morris, Tasker & Co....	187 63	Requisition No. 65. Tool-steel :	
Pancoast & Maule.....	*181 76	Morris, Wheeler & Co...	138 50
W. C. Allison & Co....	273 12	Midvale Steel Works....	*46 75

*Offers for supplies for United States navy-yard at Kittery, Me., under advertisement dated November 11, 1876.*

Requisition No. 12. Gas-oil :			
	Per gal.		Per gal.
Rider & Cotton.....	*17 7½	C. Dwight Hanson.....	20½
N. T. Mathes & Co.....	17 10½	John Stokell & Co.....	19½

#### NO. 4.—BUREAU OF NAVIGATION.

##### BUREAU OF NAVIGATION, NAVY DEPARTMENT, October 31, 1876.

SIR: I have the honor to submit the following report of the Bureau of Navigation for the past year, together with estimates for its support and for the expenditures that will probably be required in that division of the naval service committed to its immediate charge for the fiscal year ending June 30, 1878. Included in this report, and transmitted herewith, are the reports and estimates of the several offices under its cognizance, and an abstract of offers for supplies received.

##### NAVIGATION.

The bureau, with the consent of the Department, has removed the compass-stations, for the reasons stated in last year's report. Other means have been provided for making deviation-tables speedily and

correctly, whenever desired. This should be done several times during a cruise, and always when the vessel changes greatly her geographical position.

The appended report of Professor B. F. Greene, United States Navy, charged with the superintendence of compasses, gives detailed information on this important subject.

#### HYDROGRAPHY, CHARTS, AND BOOKS.

The Hydrographic Office increases yearly its sphere of usefulness, and supplies in general our Navy and our merchant-marine with nautical charts, sailing-directions, and hydrographic information generally. The appended report of the Hydrographer, and the suggestions made therein, will doubtless receive your careful consideration.

The work of telegraphic determinations of longitude in the West Indies has been brought to a close for the present, having, indeed, been carried as far as is practicable at this time. The results have been satisfactory. The work was ably conducted by Lieut. Commander F. M. Green, in command of the *Gettysburg*, whose report gives in detail all of the latitudes and longitudes determined to the nearest limit of error.

By your orders, this work will be extended this winter, by means of chronometric and other determinations between the island of Trinidad and Aspinwall, along the northern coast of South America.

The *Gettysburg*, now under the command of Lieut.-Commander H. H. Gorringe, is engaged in obtaining information in localities found deficient in the sailing-directions of the Mediterranean. As the work of compiling what has been published was done by this officer, he is specially qualified to supply deficiencies in information.

A vessel named by you as likely to be available for making a running survey of the coast of Guatemala has been supplied partially with instruments and deep-sea sounding apparatus for use in transit.

The bureau has to regret that in several cases, and indeed in every case where this sounding-apparatus has been furnished to vessels-of-war without specific instructions for sounding, not a single cast has been made. This will make it advisable hereafter to furnish this apparatus only in exceptional cases, accompanied by specific orders for sounding.

At the time of my last report, the *Tuscarora*, under the command of Commander J. N. Miller, was commencing a line of soundings from the Sandwich Islands to the Feejee Islands, and thence to the port of Brisbane, Australia; further projected soundings were not made, owing to the work having already been done by the English.

These soundings are of great interest to scientists, and afford definite information to those who may be interested in submarine cables between the points named.

This sounding was done by the *Tuscarora* without interfering with her important duties as a vessel-of-war, and afforded a practical illustration that deep-sea soundings, as now made, require no sacrifice to that work as a specialty.

Several years consecutively this bureau has asked appropriations for establishing the survey of the North Pacific Ocean on a proper basis, and has endeavored to show what should be done, and that it properly belongs to our Government to do it. A steamer properly built for the work, and two three-masted schooners, with the necessary outfits, would cost two hundred thousand dollars, and, when at work, this force would be maintained at less cost than an ordinary cruiser, and in addition to

serving usefully as vessels-of-war would, by co-operating, spare great labor in establishing positions, in making excellent running surveys, and thus rendering comparatively safe the navigation of that great ocean.

The instrumental location of a transcontinental ship-canal-line on the isthmus of Panama, as well as that known as the Atrato-Napipi route, remains unpublished from a lack of the necessary appropriations. The maps, plans, and calculations have been made for more than one year.

It is intended to keep the libraries of our ships-of-war up to the requirements of the age by adding new publications which appear to be calculated to extend the usefulness of the Navy, which goes beyond mere efficiency in our vessels for war purposes, as is shown in the collateral employment of our vessels-of-war under the command of and aided by able and efficient officers.

#### CONTRIBUTIONS TO THE INTERNATIONAL CENTENNIAL EXHIBITION.

This bureau has complied with all requirements from the representative of the Navy Department at the Government Exhibition in supplying articles of interest under its cognizance, comprising compasses, and the various nautical, meteorological, surveying, and plotting instruments; deep-sea and ordinary sounding implements; running, signal, and other lights; night-signals; nautical charts and sailing-directions; a flag-ship's library, and a collection of national flags from the earliest period of this Government to date, as well as distinguishing and signal flags; and it is gratifying to state that the contributions from this bureau were appreciated as a very interesting part of the display made by the Navy.

#### NAVAL OBSERVATORY.

The report of the Superintendent of the Naval Observatory, herewith appended, presents the subjects under his charge so fully as to require no special notice of this bureau.

#### NAUTICAL ALMANAC.

The report of Prof. J. H. C. Coffin, charged with the calculations, reductions, and publication of our Nautical Almanac, requires special attention. The calculations and reductions are made years in advance, and indeed the publications must be also, in order to fulfill their purposes. Without sufficient appropriations this cannot be done.

#### SIGNALS AND SIGNAL-OFFICE.

The appended report of the Chief Signal-Officer of the Navy will be read with interest, affording as it does evidence of increased efficiency.

The tactical and general signal-books are now completed and issued, and a blind established which will render the possession of the signal-books, with the blind included, of no value to an enemy.

New methods of night-signaling for fleets have been satisfactorily tested, and still further success seems to be assured, whilst the use of electricity for lighting vessels-of-war and for signaling seems to be probable ere long. Indeed, for signaling it is only unemployed now because it is relatively expensive.

The Chief Signal-Officer, with two assistants, is now endeavoring to establish a practicable method of phonetic signaling, sufficiently inex-

pensive, if possible, to allow its use on board of merchant-steamers and sailing-vessels for indicating at least the course steered, and, with vessels-of-war, for communicating with each other in fogs and thick weather, orally, in the same manner as is done visually by the Army signal method.

#### OFFICE OF DETAIL.

The naval service supplies twenty officers employed under the Treasury Department in the various duties connected with the Light-House Establishment and the inspection of light-houses. It furnishes, also, fifty officers, of different grades, engaged in the hydrographic work of the Coast Survey, who are thus gaining an experience that will be of great advantage, prospectively, to the Navy, even when it is considered strictly for war purposes, whilst the Government gains the advantage of employing this large number of officers in purely civil pursuits to render navigation safe. It must be borne in mind that their pay and maintenance is chargeable to the naval appropriations, and that their services elsewhere entail a considerable expenditure that would otherwise not be incurred by the Navy.

#### CONTRACTS.

With the exception of illuminating-oils, and commanders' and navigators' stationery, the supplies with the furnishing of which this bureau is charged are of such special nature as to forbid the exercise of the contract system, but necessarily demand a purchase by careful selection, and at fair prices to dealers and instrument-makers.

Respectfully submitted.

DANIEL AMMEN,  
*Chief of Bureau.*

Hon. GEO. M. ROBESON,  
*Secretary of the Navy.*

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OFFICE OF SUPERINTENDENT OF COMPASSES,  
BUREAU OF NAVIGATION, NAVY DEPARTMENT,  
*Washington, October 20, 1876.*

SIR: I have the honor to submit herewith the following synopsis of my annual report to the bureau for the current year:

#### THE NAVY COMPASS.

Relative to the Navy compass, reference is made to an improvement recently proposed by Mr. Ritchie, in the card-magnets, consisting in the substitution of bundles of steel wire for the piles of thin laminæ now used. Certain advantages of these magnets are specified as made apparent, and a trial of a few compasses, thus fitted, at sea, is recommended.

Mention is made of the compass-case, fitted up under your orders, in the Government building of the International Exhibition, and a list of its contents is given.

#### COMPASS INSPECTION.

Under this head a detailed description of the compass-testing instrument, recently constructed, is given. This instrument is intended to



be used as an auxiliary to the compass observatory, near Boston, in the examination of the Navy compasses at the several navy-yards, after the compasses are turned in from cruises at sea; and the practicability of making these examinations, where they are liable to encounter large compass disturbances from magnetic surroundings, is justified by certain peculiarities in the construction and use of this instrument.

#### MAGNETISM OF SHIPS AND COMPASS DEVIATIONS.

*Magnetic examination of the Alert and Huron.*—A detailed statement of the magnetic examination of the new iron sloops of war Alert and Huron, during last winter, is presented. The results comprise the deviations of the standard and steering compasses, with the corresponding magnetic elements of both ships, from three sets of observations; of which two sets were made under steam, first with the port helm and next with the starboard helm, and one set with the smoke-funnel lowered.

In reviewing these results attention is called—

First, to the characteristic differences in both the polar and quadrantal forces, and in the corresponding compass deviations, according as the direction of the swing was to the right or to the left, and which are more decided as the changes in heading were more rapid. It is shown that these evidences of tardiness in the inductive action appear to be at the least as decided for the polar as for the quadrantal force. Allusions are made to the theoretical considerations bearing upon this question; and it is suggested that in practice there is need of certain precautions, if entirely reliable observations are to be made.

Secondly, to the remarkable changes of the standard compass of the Alert since the examination of that vessel in 1875. These changes are attributed in part to the shortening of the smoke-funnel and in part to the cutting away of the lower sections of the iron rail upon the mizzen mast, the two removed portions having probably concurred as a partial polar corrector of the compass.

Thirdly, to the influence of lowering the smoke-funnel during the third set of observations on board each ship.

Fourthly, to the existence of well-defined sextantal deviations, in addition to the usual polar and quadrantal deviations, at the steering-compass of the Alert, with allusions to theoretical considerations.

#### THE ADJUSTABLE BINNACLE.

A detailed description is given of the new adjustable binnacle with polar, quadrantal, and vertical correctors, affording facilities not only for the convenient magnetic correction of the compass, but for a complete definite registry of the corrections, as separately made, as well as for subsequent re-adjustments and registrations, either at sea or in port.

I am, sir, very respectfully, your obedient servant,

B. F. GREENE,

*Professor of Mathematics U. S. N., Superintendent of Compasses.*

Commodore DANIEL AMMEN, U. S. N.,

*Chief of Bureau of Navigation,*

*Navy Department.*

UNITED STATES HYDROGRAPHIC OFFICE,  
*Washington, D. C., September 16, 1876.*

SIR: In compliance with the bureau order of August 4, 1876, I have the honor to forward herewith the estimates of this office for the year ending June 30, 1878.

During the year ending June 30, 1876, the work accomplished by this office has been as follows: Five new plates engraved; ten in process of engraving; fifty-seven charts have been prepared and photolithographed; and thirty-five plates corrected, to a greater or less extent, as information requiring it has been received.

Sailing directions: "The Navigation of the Pacific Ocean;" "The West Coast of Africa," Volume II; "The Coasts and Islands of the Mediterranean," Part I; and "The Coasts and Ports of the Bay of Biscay," have been published and issued. Volume I of "The Directions for the West Indies and Gulf of Mexico;" Part II, "Mediterranean;" Volume III "West Coast of Africa;" and "The Northern Coast of France," are in hand and progressing favorably.

The Directions for the coast of Chili, Bolivia, and Peru have for several months been awaiting their turn at the Public Printer's; the usual foreign "Light-house Lists," "Hydrographic Notices," and "Notices to Mariners" have been issued.

The determination of longitudes in the West Indies by the electric telegraph, by the party in charge of Lieut. Com. F. M. Green, U. S. N., in the United States steamer Gettysburg, has been completed most satisfactorily.

The positions of Key West, Havana, Santiago de Cuba, Kingston, (Jamaica,) Aspinwall, Panama, San Juan de Porto Rico, St. Thomas, Santa Cruz, St. Pierre, (Martinique,) Bridgetown, (Barbados,) and Port Spain, (Trinidad,) have been occupied, the measurements being made from Key West, the position of which had been determined with great accuracy by the United States Coast Survey. The observations are now being computed for publication. For the first time the latitudes and longitudes of these islands have been determined accurately, so as to admit of no question.

On the return of the Gettysburg some intervals in the soundings made by Her Britannic Majesty's steamer Challenger between St. Thomas and Bermuda were filled in, the line of soundings being continued from Bermuda to Cape Henry; the greatest depth obtained was 3,950 fathoms, confirming those made by the Challenger.

The sounding-machine invented by Sir William Thompson, with improvements by the Bureau of Navigation, and the piano wire for sounding, have in this, as in every other instance, given satisfactory results. The instruments used in the determination of longitudes are in good order and require no expenditure; it is to be hoped that it may be found practicable at a future period to continue these valuable determinations.

During the fiscal year the agents of this office have sold five thousand and thirty-one (5,031) charts, and one thousand and nineteen (1,019) sailing directions, and other publications of the office.

As the estimates of the office have been only such as to admit with economy of its gradual progress toward meeting all the demands of the commercial and naval marine, the reduction of the appropriation for the fiscal year ending June 30, 1877, will cripple the office in its progress, debarring it from publishing much of its work as completed; this will especially be the case if unable, from want of appropriation, to print works which are now ready and others which will soon be ready for the press.

The greater number of charts from the survey of the United States steamship *Narragansett*, Commander Dewey, on the coasts of Lower California and in the Gulf of California, are as yet not engraved. The appropriations requested for completing the work have not been granted. The replotting of it has been carried on as rapidly as the small force at the disposal of the office would permit, and the few which have been engraved have been completed at the sacrifice of other office-work. I may here mention that the general charts of Commander Dewey's survey have already been engraved by the British Admiralty Hydrographic Office, who lose no time in placing before the public everything which is of assistance to navigation. I submit an estimate for this work, as also for the continuance of the survey into the Pacific Ocean, regarding it as of the greatest importance for the safety of navigation to have all the dangers existing there thoroughly examined and determined.

With regard to the rented building occupied by this office, I will state, as in my former reports, that it is in no respect fire-proof, and that it does not contain the requisite space. As heretofore, I recommend that a building be purchased and fitted up for a Hydrographic Office.

Very respectfully, your obedient servant,

R. H. WYMAN,

*Commodore United States Navy and Hydrographer.*

Commodore DANIEL AMMEN, U. S. N.,

*Chief of Bureau of Navigation,*

*Navy Department.*

UNITED STATES NAVAL OBSERVATORY,  
*Washington, October 20, 1876.*

SIR: In compliance with the bureau's instructions of the 28th ultimo, I have the honor to submit a report of the operations of this institution for the past year:

#### THE GREAT TELESCOPE.

Since my last report, observations with the 26-inch refractor have been made continuously. The satellites of the outer planets, Neptune, Uranus, and Saturn, have been carefully observed, and also a number of the more interesting and difficult of the binary stars. The observations of the satellites and of the companion of Sirius have been communicated to the *Astronomische Nachrichten*. A paper containing an account of the search for the companion of Procyon, discovered by Mr. Otto Struve, director of the Pulkova Observatory, has been communicated to the American Academy of Arts and Sciences at Boston, and also to the *Astronomische Nachrichten*. The result of this search is, that none of the observers at Washington have been able to see the companion found and observed by Mr. Struve and his assistant; but they have discovered three other close companions of Procyon, and conjecture the existence of several more. The new companions of Procyon were first seen here by Professor Holden, and afterwards by Professors Newcomb, Watson, and Peters, and by Mr. David P. Todd. Some of these companions have also been seen in Cambridge, Mass., by Messrs. Clark, with the 26½-inch objective made by them for Mr. McCormick.

The figure of the object-glass not being quite perfect, and the flint lens having become slightly stained, the makers, Messrs. A. Clark & Sons, proposed to repolish this lens. The work was undertaken by them on April 21st and was finished May 4th of the present year

The figure of the glass is now very nearly perfect, and the stains have been removed from the flint-lens. The work was done by Messrs. Clark without compensation, further than their transportation to and from Washington, and their subsistence while here.

Mr. A. G. Clark, while testing this objective, found the star  $\epsilon$  Coronæ Borealis, a close and difficult double star. As this may prove an interesting binary, I give here the results of the observations made by Professor Hall:

1876.4. Angle of position,  $= 350^{\circ}.5$ ; distance,  $= 2''.12$ ; 3 nights.

The magnitudes are 4 and 12.

The dome is in good condition, and is moved with ease, considering its size. In March, the cog-work by means of which the dome is moved became loose, and it was necessary to bolt it to the frame-work; but beyond this slight improvement the dome has needed no repairs. The canvas curtain which covers the opening in it, weakening by constant exposure, is easily torn by the wind, and needs renewing every year. Still, this manner of covering so large an opening seems to be the most convenient.

The driving-clock continuing to be troublesome, and frequently stopping, it was taken down on July 2d, and the bearing of the shaft that carries the conical pendulum was changed. This bearing was a conical steel cup, into which was fitted the conical point of the shaft. On examination the point of the shaft was found to be worn and rough, probably through heating. In place of the conical steel cup, Mr. Gardner, the instrument-maker, put a plane agate surface, and gave the lower end of the shaft a spherical surface of large radius. To guide the shaft, an oil-cup is raised around the agate, and the upper surface of this cup forms a ring the size of the shaft. The clock now runs with much less noise and jar than before, and thus far has given but little trouble. The telescope and the entire apparatus are now in good condition, and are in constant use.

*The transit circle.*—This instrument, under the direction of Professor J. R. Eastman, assisted by assistant observers Edgar Frisby, A. N. Skinner, and H. M. Paul, has been employed, as in the preceding year 1874-75, in observations of the sun, moon, and planets, and of a large list of miscellaneous stars whose places were desired, first, as zero-points for the formation of a catalogue from the zone observations made here in the years 1846 to 1849; secondly, for the use of Lieut. G. M. Wheeler, Corps of Engineers, United States Army, in the reduction of the zenith-telescope work of his parties engaged in surveying and exploring the western Territories; and, thirdly, for the use of Lieut. Com. F. M. Green, in his determinations of latitude in the West Indies.

Considerable progress has been made in the observation of the list of stars from the British Association Catalogue, between  $120^{\circ} 0'$  and  $131^{\circ} 10'$  north polar distance.

The observations of stars from the American Ephemeris have been generally limited to those necessary for the determination of time and azimuth, and for reflection observations.

In October, 1875, clock signals were exchanged on five nights with the observatory of Lehigh University, Bethlehem, Pa., to determine the longitude of that observatory. A report of this work will appear in an appendix to the volume of 1875.

The roof of the transit-circle observing-room is still in a very bad condition, and should be rebuilt on an entirely different plan.

*The 9.6-inch equatorial.*—This instrument is under the charge of Professor Eastman, with Messrs. Frisby, Skinner, and Paul as assistants.

It has been employed in the observation of occultations, and in identifying asteroids whose places are not well known.

*Mural circle and transit instrument.*—With the transit instrument Professor Yarnall has been observing such stars as had not been sufficiently observed in the catalogue which was published for the years 1845 to 1871; and other stars whose places have since been observed in declination with the mural circle. He has reduced these stars to their mean places, and they are now ready for a new edition of that catalogue. He has also been engaged in preparing for publication that portion of the annual volume for 1874 which is now in press. He was assisted by Professor Lockwood until the latter's retirement in August last.

*The meteorological department* has been in charge of Professor Eastman, and the usual observations with the barometer, and the dry, wet, and solar thermometers have been made at 0<sup>h</sup>, 3<sup>h</sup>, 6<sup>h</sup>, 9<sup>h</sup>, noon, 3<sup>h</sup>, 6<sup>h</sup>, and 9<sup>h</sup> on each day. The observations for 1875 were ready for the printer in August, and, though unavoidably delayed, 200 extra copies will soon be ready for distribution to our meteorological correspondents.

*Chronometers.*—There are at present 82 chronometers under comparison, of which 58 are ready for issue and 24 are undergoing trial. There are 28 in the hands of Messrs. Negus undergoing repairs. This firm has continued to do the cleaning and repairing of instruments for the Observatory, and has sent here 25 chronometers during the year in good order. Fifty-three chronometers and seven watches have been received from all sources, and 34 chronometers and 6 watches have been issued for use.

Lieut. Commander C. H. Davis was ordered to duty October 23, 1875; Lieut. T. N. Lee, 15th November; Lieut. J. J. Brice, 1st December; Lieut. Commander G. W. Pigman, March 1, 1876; Lieut. C. H. Arnold was detached November 12, 1875; Lieut. J. J. Brice, March 7, 1876; Lieut. T. N. Lee, May 31. The last was re-ordered September 19, 1876. Those on duty at present are Lieut. Commanders C. H. Davis and G. W. Pigman; Lieut. Edward W. Sturdy (ordered on the 14th instant) and Lieut. T. N. Lee.

*Investigation of the moon's motion.*—Three computers are now employed on this work under direction of Professor Newcomb, with the appropriation of \$3,000 for the purpose. It is hoped that the discussion of all recorded observations of eclipses and occultations from the earliest historical times till 1750 will be nearly completed during the present fiscal year, and will be ready for publication by the end of 1877. The theoretical investigation of the inequalities due to the action of the planets may require a longer time for their completion. An appropriation of \$1,200 is therefore asked for, which will suffice for the employment of a skilled computer through the next fiscal year.

*Reduction of transit of Venus observations.*—This work is going forward as fast as the limited balance of past appropriations in the hands of the commission will admit. The time observations, and errors and rates of chronometers at all the stations are nearly computed, and the latitudes are all determined. Prof. T. H. Safford has been temporarily employed in the tedious investigations necessary to determine the longitudes of the stations, and in preparing the tables necessary for reducing the photographic negatives. Next to the determination of longitudes, the most laborious part of the work which remains to be done is the measurement of the photographic negatives. The commission assigned this work to Professor Harkness, in June, 1875. By him the sine flexures of the eight transit instruments used by the observing

parties have been carefully determined by means of horizontal and vertical collimators, erected in the fire-proof for that purpose. The inequalities of the pivots of these transits have also been determined, the instrument employed in the work being Professor Harkness's new spherometer-caliper.

Owing to bad weather, more than half the photographs of the transit of Venus are so faint that it is not possible to see them through an ordinary microscope. A series of experiments undertaken to overcome this difficulty, resulted in the construction of a new form of micrometer microscope, which renders it possible to measure all these pictures with a good degree of accuracy. Besides this new optical arrangement, other additions have been made to the measuring engine, which greatly facilitate its use, and considerable progress has also been made in investigating the errors of its glass scales.

The observations made at the Hobart Town station for the telegraphic determination of the difference of longitude between that place and Melbourne, have been reduced, but the final value of the longitude cannot be given because the simultaneous observations made at the Melbourne Observatory have not yet been received.

The observations for telegraphic difference of longitude between the Hobart Town and Campbell Town stations have been completely reduced, and result in placing Campbell Town thirty-nine seconds and fifty-six hundredths of time ( $39^{\circ}.56$ ) east of Hobart Town.

Blank forms have been prepared for the reduction of the chronometrical differences of longitude, and much progress has been made in the computation of the longitude of the Kerguelen station, but the final result has not yet been obtained.

*International Exhibition, 1876.*—In response to inquiries made by the Bureau of Navigation in regard to the amount of space desired by the Observatory for its exhibit at the International Exhibition, request was made of the "Board on behalf of the Executive Departments" for placing the following classes of objects, the plan and estimates for the exhibition of which were approved by the Secretary of the Navy:

1. A copy of each volume of the astronomical and meteorological observations issued by the Observatory from the date of its founding, 1845.

2. The distinct treatises which have issued pertaining to the subjects constituting part of its investigations.

3. A selected number of chronometers of American manufacture, taken from those on hand for issue to United States vessels.

4. A set of the instruments actually employed in observing the transit of Venus, December 8-9, 1874, the instruments being mounted in a set of buildings similar to those which were constructed for the actual observations and transported to the several stations in each hemisphere. This part of the exhibit was designed to show the modes in which the observations were made and recorded, and to illustrate American aptitude for expeditionary astronomical work.

5. The illustration of American Arctic exploration from the year of the first Grinnell expedition, (De Haven and Kaue,) 1850, to the year of the death of Captain Hall, 1871. With this subject, the Observatory had been again brought into official relation.

The full amount of space required in the Government building and within the grounds of the Centennial having been readily accorded by the representative of the Navy Department, Rear-Admiral Jenkins, the exhibit of the objects heretofore named has been satisfactorily made. The care of placing the astronomical portion was intrusted to Prof.

William Harkness, one of the observers of the transit of Venus, 1874, assisted by Mr. W. F. Gardner, instrument-maker of the Observatory; that of the publications and of the Arctic collection was intrusted to Prof. J. E. Nourse.

While making up this collection, contributions from distinguished friends of the American explorers, and particularly from those who took part in the different expeditions, including officers of the Navy, were cordially offered and their receipt acknowledged; efforts being made to link to the Centennial all who had been directly interested in our explorations.

The catalogue of "Navy Department exhibits," recently published at the International Exhibition, contains accurate descriptive lists of the objects furnished by the Observatory.

*The Library.*—The increase in the number of volumes (principally by exchanges) has somewhat exceeded that of former years. The distribution of the annual volumes, besides supplying the calls for results of the investigations of the Observatory by its collaborators in the various observatories and other scientific institutions of the world, brings back rich gratuitous exchanges to build up our own resources.

The volume of observations made during the year 1873, has been widely distributed. An appendix to the volume for the year 1874, containing a condensed account of the Observatory, a list of publications, and a brief description of each of the instruments, illustrated by heliographs, has been received from the press in advance of the volume, and is now being distributed to those who are directly interested in astronomical work.

Very respectfully, your obedient servant,

C. H. DAVIS,

*Rear-Admiral, Superintendent.*

Commodore DANIEL AMMEN, U. S. N.,

*Chief of Bureau of Navigation, &c., Navy Department.*

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No. 16.

NAUTICAL ALMANAC OFFICE,

*Washington, D. C., October 19, 1876.*

SIR: I have the honor to submit the following report of the operations of this office during the past year.

The preparation of the American Ephemeris and Nautical Almanac has continued as in previous years. The Ephemeris for each year comprises all relating to the places of the sun, moon, principal planets, and standard stars that is desired by astronomers in such a work.

During the past year 418 copies have been sold, and 627 have been distributed to the ships and stations of the Navy; to the surveying and exploring parties of the Army; the Coast Survey and the Land Office; to observatories and astronomers, and to various colleges and other public institutions, especially to those in which astronomical observations or investigations are conducted.

A smaller volume, containing the first half of the complete Ephemeris, is published for the use of navigators. More than 3,500 copies of the almanac for each year are required for the supply of merchant-ships.

There have been printed during the year 1,000 copies of the Ephemeris for 1877; 500 of the Ephemeris for 1879; 3,000 of the small almanac for 1877; 1,000 of the small almanac for 1879.

The small almanac for 1879 was received from the printer in January, and the complete volume for 1879 in August of the present year. The latter was delayed by the exhaustion of the appropriation for printing.

The small almanac for 1880 is nearly complete and stereotyped, and it is expected that the entire Ephemeris for that year will be issued before April next.

The preparation of the Ephemeris for 1881 is in progress, but cannot be completed with the appropriation for the present year.

The preparation of the Ephemeris for 1882 will be still more delayed unless the whole appropriation requested for the next fiscal year be granted.

Considerable progress has been made in extending the star tables of the American Ephemeris from 1800 to 1900. But it has become necessary to suspend this work until a new appropriation becomes available. The want of it will delay still more the preparation of the Ephemeris for 1881.

Of the 167 small planets, 49 have been discovered by American astronomers. It is desirable that ephemerides of all of these should be prepared by citizens of the United States. The appropriation of \$3,000 a year for this purpose enables me to provide for 25 only. The compensation allowed for each is inadequate for the labor required.

I have already submitted estimates for the expenses of this office in the next fiscal year.

I am, very respectfully, your obedient servant,

J. H. C. COFFIN,

*Prof. of Mathematics, U. S. N., Sup't.*

Commodore DANIEL AMMEN, U. S. N.,

*Chief of Bureau of Navigation, Navy Department.*

#### UNITED STATES NAVAL SIGNAL-OFFICE,

*Annapolis, Md., September 26, 1876.*

SIR: I have the honor to report to the bureau that the operations at this office during the past year have been confined to an elaborate series of experiments with the electric light of Professor Farmer, and with signal bombs, rockets and candles of various kinds, (as made known to the bureau in my special reports from time to time,) and to the completion of the new general-signal book which was issued to the service on the 1st instant.

The Coston signal now in use in the Navy so lights up a ship as to disclose her size, armament, &c., to every vessel in her vicinity, and blinds the men on deck—serious objections in time of war, and when going through a great thoroughfare like the British Channel, or in and out of a crowded port; and I would, therefore, recommend that the signal-candle (which burns in the air and can be seen by all the vessels of a fleet at the same instant) be substituted for it, until the electric light takes the place, (as it ere long must, I think) of all other night-signals.

Working by the flash system, signals made by Farmer's electric light were read in my presence at the distance of six miles with great rapidity and exactness, at the torpedo depot, this summer, for three consecutive nights, without a single mistake being made; and on the last night of my stay there Professor Farmer so placed the lantern that its rays were thrown vertically in the air; then, working it by hand, he made the



"one," "two," "three," of the Myers code, thus demonstrating the practicability of using the air as a "screen" for signaling. The night on which this experiment was made was beautifully clear, and there seemed to be the slightest possible moisture in the atmosphere.

Professor Farmer expresses the opinion that electricity may be used on board our ships, not only for signaling, but for lighting them safely and economically; and, in view of the great importance of the matter, I trust I may be permitted to express the hope that Congress, at its next session, will make a special and liberal appropriation for electric purposes.

The quarterly reports of the various vessels in commission show an improvement in the signal corps of the Navy.

As the office is to be removed to the Navy Department, the sum of \$840 will be sufficient for its maintenance, distributed as follows;

Laborer's wages.....	\$540 00
Contingent expenses.....	300 00
	<hr/> 840 00

I am, sir, respectfully, your obedient servant,

FOXHALL A. PARKER,  
Commodore, and Chief Signal-Officer.

Commodore DANIEL AMMEN, U. S. N.,  
Chief of Bureau of Navigation, &c., Washington, D. C.

#### BUREAU OF NAVIGATION.

*Estimate of appropriations required for the service of the fiscal year ending June 30, 1878, by the Bureau of Navigation.*

##### FOR THE SUPPORT OF THE BUREAU OF NAVIGATION.

For salary of chief clerk, (Revised Statutes, page 69, section 416, and act of August 15, 1876).....	\$1,800 00
For salary of one clerk of third class, (Revised Statutes, page 26, section 167, and act of August 15, 1876).....	1,600 00
For salary of one clerk of second class, (act of August 15, 1876).....	1,400 00
For salary of messenger, (act of August 15, 1876).....	840 00
For salary of laborer, (act of August 15, 1876).....	720 00
For contingent expenses.....	800 00
Total.....	<hr/> 7,160 00 <hr/>

*Estimate of appropriations required for the service of the fiscal year ending June 30, 1878, by the Bureau of Navigation.*

#### A.

##### 1.—FOR NAVIGATION.

For foreign and local pilotage and towage of ships-of-war.....	\$55,000 00
For payment of canal dues and other charges incidental to passing through canals, (inapplicable to any other purpose).....	7,000 00
For services and materials in correcting compasses on board ship, and for adjusting and testing compasses on shore.....	3,000 00
For nautical and astronomical instruments, nautical books, maps, charts, and sailing-directions, and repairs of nautical instruments for ships-of-war.....	11,000 00
For books for libraries for ships-of-war.....	3,000 00

For navy signals and apparatus, namely: signal-lights, lanterns, rockets, including running lights, drawings, and engravings for signal-books...	\$6,000 00
For compass-fittings, including binnacles, tripods, and other appendages of ships' compasses.....	7,000 00
For logs, and other appliances for measuring the ship's way, leads, and other appliances for sounding.....	3,000 00
For lanterns and lamps, and their appendages, for general use on board ship, including those for the cabin, ward-room and steerage, for the hold and spirit-room, for decks and quartermaster's use.....	5,000 00
For bunting and other materials for flags, and making and repairing flags of all kinds.....	5,000 00
For oil for ships-of-war, other than that used in the engineer department, for candles, when used as a substitute for oil in binnacles, running-lights, for chimneys and wick, and for soap used in the navigation department.	24,000 00
For stationery for commanders and navigators of vessels-of-war, and for use of courts-martial.....	2,000 00
For musical instruments and music for vessels-of-war.....	1,000 00
For steering signals and indicators, and for speaking-tubes and gongs for signal-communication on board vessels-of-war.....	3,000 00
For payment of bill of Messrs. Anthony & Chew, for general average on stores shipped per steamship General Sedgwick, in January, 1871.....	136 44
<b>Total.....</b>	<b>135,136 44</b>

## 2.—FOR NAVIGATION—CONTINGENT.

For freight and transportation, postage and telegraphing on public business, advertising for proposals, packing-boxes and materials, and all other contingent expenses.....	\$5,000 00
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## 3.—FOR NAVIGATION—HYDROGRAPHIC WORK.

For drawing, engraving, purchase of chart-paper, printing and photolithographing charts, correcting old plates, preparing and publishing sailing-directions and other hydrographic information.....	\$60,000 00
For fuel, lights, and office-furniture, care of building and other labor, purchase of books for library, drawing materials, and other stationery, postage, freight, and other contingent expenses.....	5,000 00
For rent and repair of building.....	2,800 00
For completing and engraving charts of the survey made of the coast and gulf of lower California and the mouth of the Colorado River.....	7,000 00
For continuing the survey of the Pacific Ocean and of the reported dangers to navigation.....	15,000 00
<b>Total.....</b>	<b>89,800 00</b>

## B.

## 1.—FOR NAVAL OBSERVATORY.

For three assistant observers, at \$1,500 each.....	\$4,500 00
For one clerk.....	1,800 00
For one instrument-maker, three watchmen, one messenger, and one porter, keeping grounds in order, repairs of buildings and inclosures, fuel, light, and office-furniture, professional books for library, chemicals for batteries, stationery, freight, and all contingent expenses.....	13,500 00
NOTE.—The sum of \$13,500 was, for many years, the amount annually appropriated. The reduced sum has proved inadequate for the maintenance of the establishment and the preservation of the buildings.	
For theory and tables of the moon's motion.....	1,200 00
For reducing and transcribing astronomical and meteorological observations for publication.....	2,200 00
<b>Total.....</b>	<b>23,200 00</b>

## 2.—FOR NAVAL OBSERVATORY.—TRANSIT OF VENUS OBSERVATIONS.

For completing reductions of observations of the transit of Venus.....	\$5,000 00
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## 3.—FOR NAVAL OBSERVATORY.—TRANSIT OF MERCURY OBSERVATIONS.

For expenses of observing the transit of Mercury on May 6, 1878, at various points in the United States.....	\$1,500 00
Total under Naval Observatory.....	29,700 00

## C.

## 1.—NAUTICAL ALMANAC.

For pay of computers and clerk for preparing for publication the American Ephemeris and Nautical Almanac.....	\$20,000 00
For rent, fuel, labor, stationery, boxes, expresses, books, and miscellaneous expenses.....	1,500 00
For continuance of work on new planets discovered by American astronomers.....	3,000 00
Total.....	24,500 00

NOTE.—The estimate for pay of computers, &c., is for the amount usually appropriated in previous years and found to be necessary for the successful prosecution of the work.

## RECAPITULATION.

*Estimate of appropriations required for the fiscal year ending June 30, 1878, by the Bureau of Navigation, Navy Department.*

## FOR SUPPORT OF BUREAU.

Salaries and contingent.....	\$7,160 00
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## FOR THE NAVAL SERVICE.

A 1. Navigation.....	\$135,136 44
2. Navigation, contingent.....	5,000 00
3. Navigation, hydrographic work.....	89,800 00
B 1. Naval Observatory.....	23,200 00
2. Naval Observatory, transit of Venus observations.....	5,000 00
3. Naval Observatory, transit of Mercury observations.....	1,500 00
C 1. Nautical Almanac.....	24,500 00
Total.....	244,136 44

*Offers to furnish ten thousand gallons lard-oil at the New York navy yard, under advertisement authorized by the Bureau of Navigation, July 18, 1876.*

	Per gallon.
Chard, Howe & Weber*.....	\$0.92½
Manhattan Oil Company.....	0.97
S. C. Carll.....	0.97½
J. H. Walker.....	1.004½

## No. 5.—BUREAU OF EQUIPMENT AND RECRUITING.

NAVY DEPARTMENT,  
BUREAU OF EQUIPMENT AND RECRUITING,  
October 23, 1876.

SIR: I have the honor to submit the annual report of this bureau, with the estimates for its support for the fiscal year ending June 30, 1878.

During the past fiscal year 99 vessels have been either partially or wholly equipped under this bureau at the several navy-yards, at an ex-

\* Accepted.

penditure for labor of \$320,000, the greater part of the materials having been supplied from the stock on hand, which, however, is rapidly diminishing.

Sixty-one thousand three hundred and eleven tons of coal have been purchased at home and abroad for the use of the Navy, under this bureau, costing, including freight and shipments, \$623,237.76.

Three hundred tons of hemp have been purchased, costing \$91,459.92.

The rope-walk at Charlestown navy-yard has supplied the wants of the service with wire, hemp, manila and hide rope.

The equipment-shops at the Washington navy-yard have furnished all the anchors, chains, &c., needed for the service.

#### IMPROVED GALLEY.

Since my last report an improved galley has been introduced into the Navy, at a slightly less cost than the old one, and with a material economy in fuel and increased facilities for cooking; dispensing in smaller ships with the former cumbersome and expensive bake-oven.

If the same improvements (which are patented) can be introduced in the galleys manufactured at the Washington navy-yard, it will be advisable to manufacture them there in preference to buying of private parties.

I earnestly recommend that in future all galleys on single-decked ships be placed under the top-gallant forecastle.

#### CHAIN-IRON.

During the past few years quite a number of ships have parted their chains without undue strain. A series of experiments instituted by my predecessor, and conducted by Commander Beardslee, disclosed the fact that much of the iron used in the manufacture of chains for the Navy was defective in the necessary qualities.

In consequence of these experiments, the testing-machine at the Washington navy-yard has been placed in thorough order, and its accuracy established; the proof-table has also been revised.

All iron for the above purpose is now examined by a board of officers before purchase, and I have reason to believe that we are at present manufacturing chains and anchors of the very best quality.

#### STEEL-WIRE HAWSERS.

During the past year the subject of wire hawsers has engaged the attention of the bureau.

Wire hawsers are coming into use in foreign navies, particularly for towing purposes. They have advantages over hemp and manila, which it is not necessary to mention here.

The bureau has hitherto found it impossible to obtain steel wire in this country of the requisite strength. A quantity was imported from England, and a steel-wire hawser of  $7\frac{1}{4}$  inches in circumference was manufactured at the rope-walk in the Boston navy-yard, and is now on exhibition at the Centennial.

The commandant at the Boston yard has orders to manufacture two more hawsers, one of foreign steel and one of domestic, if it can be obtained. These hawsers are intended for towing the monitors.

In this connection, a board of officers is now in session at the Washington navy-yard for the purpose of reporting upon iron and steel wire

for standing rigging and hawsers, their comparative qualities and cost, the best method of preserving them from deterioration, and to ascertain the best manufacturers, &c.

I anticipate the time when wire will not only be used for hawsers, but for the more important purpose of anchoring ships. Wire cables have so many advantages that I think they must eventually be adopted.

#### ALLOWANCE-BOOK.

The book of allowances for this bureau was compiled at a time when men-of-war were forced to be self-sustaining, for very often the whole term of their cruises; but now, when naval stores can be found in nearly every port, and when steam and the telegraph render communication with sources of supply so easy and so frequent, it is no longer necessary to burden the holds and other store-rooms of our ships with articles often never used. Not only economy but the health and comfort of the crew will be increased by a strict revision and curtailment of the allowances, and this is now being done.

#### RECEIVING-SHIPS IN RESERVE FOR SEA-SERVICE.

In pursuance of the policy of the Department to have the ships employed on the recruiting-stations in condition for sea-service as near as possible, the steam-frigates Colorado and Wabash are now in commission as receiving-ships at New York and Boston; the Franklin, on her way home from Europe, has been ordered to Norfolk, and the Wyoming is fitting out at Washington.

These ships constitute a reserve class, and, although not of modern type, might be employed with great advantage in any emergency arising near our coasts, as they carry formidable batteries and have steam-power.

In addition, it is considered better in every respect that men entering the Navy should be at once placed near or on board of well-disciplined ships of war in preference to mere hulks, where but little opportunity is given for drill, and where the men waiting in idleness become careless and discontented.

I believe that this change has been in every respect economical and beneficial.

#### BARRACKS FOR SEAMEN.

By authority of the Department, and in pursuance of a recommendation in my last report, the hulk Vermont is now being roofed over and fitted up as a complement to the receiving-ship at New York, with mess-hall and dormitories, capable of accommodating comfortably, and with due regard to health, from 800 to 1,000 recruits.

The Vermont thus becomes a seamen's home, and the space of ground surrounding her an exclusive drill-ground, useful both for professional and healthful exercise.

I am convinced, from inspection of naval stations abroad, that while ships are necessary at recruiting stations, the system of seamen's barracks on shore for the accommodation of recruits is much better, for economic and sanitary reasons.

It is intended to make New York the central rendezvous for the Navy, as men are more readily transferred to home and foreign stations from that point, and the facilities for collecting and maintaining them on the cob-dock are greater than at any other station.

## SAILORS' HALL, NEW YORK.

The sailors' hall mentioned in my last report as in course of erection by the Bureau of Yards and Docks has been finished, and fulfills all the purposes intended; it already contains a library of 1,200 volumes, and an organ for Sunday services—voluntary gifts from the citizens of Brooklyn and others, the organ costing over six hundred dollars.

The interest thus manifested by citizens exhibits the fact that any effort on the part of the Government for the amelioration of a neglected class of the community is instantly and substantially appreciated.

## CONDUCT-REPORTS.

The conduct-reports forwarded to this bureau quarterly, by direction of the Department, from all ships in commission, have enabled it not only to become cognizant of the character and qualifications of every enlisted man in the Navy, but to check, in a great degree, hasty and often needless punishment of the men; holding officers by frequent inspection to a more direct responsibility.

It has been found that, as a rule, the less the punishment on board, the more efficient the ship, and it will be a happy day in the Navy when this fact is more generally recognized by officers.

## FIREMEN AND COAL-HEAVERS.

The restoration of rates to firemen and coal-heavers has had a beneficial effect, by consolidating the department of steam-engineering, and simply remanding men back to their proper positions on board of a ship of war.

It is only a recognition of the fact that such a ship is, or ought to be, a full-powered steamer, intended for war purposes, using sails as auxiliary, and that the men who man the engines and take care of them in time of battle are a class by themselves, and as such must be fostered in order to be rendered efficient.

## HONORABLE DISCHARGES AND CONTINUOUS-SERVICE CERTIFICATES.

The honorable-discharge and continuous-service system, in operation for several years in the Navy, has a constantly improving tendency; gradually bringing into the service a better class of men, and rendering them desirous of remaining in it.

In connection with the training-system for boys, I look forward to the time as not distant when the Navy will possess a corps of trained seamen as permanent and proficient in their several grades as our present admirable corps of officers.

In this connection I have the honor to recommend that, after January 1, 1877, all promotions of enlisted men to higher rates shall be by examination and recommendation of a board of officers, convened by the commanding officer of the ship to which they belong, and subject to his approval.

The idea is to render these promotions more permanent, and consequently more desirable.

I have also the honor to recommend that, after the before-mentioned date, continuous-service certificates shall depend upon the good conduct of the men, and only be issued upon the recommendation of their commanding officers.

Under the present system, any man serving his term of enlistment is entitled to a continuous-service certificate, and thus the Navy is often burdened with those who have no other qualification than length of service.

The complements of our ships have been reduced to correspond in some degree with the total force as reduced by act of Congress, and it becomes highly important that we should retain only the very best men in the Navy.

#### PERMANENT APPOINTMENTS FOR PETTY OFFICERS.

Under the present regulations, any enlisted man having served three continuous enlistments, and received three "good conduct badges," is entitled to the rate of petty officer, if qualified, and cannot on subsequent re-enlistment be disgraced except by court-martial.

I would recommend that hereafter any enlisted man fulfilling these conditions shall receive from the honorable the Secretary of the Navy an appointment as a petty officer, to be held during life or good behavior, and shall be subject to detail for duty by the Bureau of Equipment and Recruiting.

The number of honorable-discharge and continuous-service men is constantly increasing, and officers should be cautioned to recommend none but the deserving for these privileges.

#### ACCOMMODATION OF ENLISTED MEN ON BOARD OF SEA-GOING VESSELS.

As I consider it the duty of this bureau to foster and protect the interests of the enlisted men of the Navy, I deem it incumbent upon me to call your attention to the constantly-increasing tendency of the officers' accommodations on board of a ship in our service to encroach upon the space allotted to the crew.

It would be a startling exhibit if the number of cubic feet of space allowed to the sailor, as compared to the space allowed to the officer, was placed in a tabulated form and submitted to inspection and criticism.

In addition to this general crowding of the crew forward by the increased size and number of state-rooms for officers, the cabins of our ships have grown into disproportionate size, not unfrequently interfering with efficiency, and always entailing a large expense in furniture and outfit.

The dimensions of these apartments should be reduced according to regulation to actual need, and not left to the discretion of the constructors, who often build or alter them to suit the natural, but selfish, desires of officers who expect to occupy them.

It is a rare thing to see anything in the outfit of a man-of-war intended to enhance the comfort or even protect the health of the enlisted men.

In this connection, the subject of ventilation of ships has never received proper attention in the Navy; but it is foreign to my especial duty, and I only allude to it as worthy of your attention.

#### COURTS-MARTIAL.

I do earnestly ask your consideration of the laws which govern our courts-martial in the punishment of enlisted men of the Navy.

The Department is constantly occupied in mitigating or modifying sentences, which, although honestly rendered, and in accordance with law, are almost uniformly found to be not only too severe on the man but injurious to the service.

There is a constant tendency to inflict "loss of pay" as one of the punishments for trivial offenses. This, in my opinion, should be limited absolutely by the period in which the offenders' services are lost to the country.

An intelligent revision of the naval code would not only harmonize it with the spirit of the age but relieve the Department in a great measure of one of its most pressing duties. The letter of the law is too severe for practice, and the spirit inconsistent with modern ideas of right and justice.

#### DESEPTION.

In my report of last year I stated that the "fear of punishment does not deter men from deserting." I am enabled to verify this statement by the records of the bureau.

During the first six months of 1875 there were 712 desertions from the entire fleet, and during the corresponding period of 1876 there were 562; the number of desertions being more than one-twelfth in 1875, and less than one fifteenth in 1876, of the whole force afloat.

I attribute this marked reduction to a growing belief among the seamen of the Navy that a more liberal system of discipline is about to prevail in the service—a discipline which will enforce the law by encouraging men with rewards for doing their duty, rather than by punishing them for its neglect.

#### TRAINING-SHIPS.

In my last report there were 260 boys enlisted for the Navy, to serve until 21 years of age. At the present date there are 479.

Of this number 221 are on board of the training ships, viz: Minnesota, 139; Monongahela, 82; 258 have passed out of the training-ships into the general service, and are distributed as follows: Hartford, 55; Essex, 77; Adams, 78; Marion, 18; Pensacola, 30.

The Minnesota, at New York, and Monongahela, at Baltimore, are in successful operation, for the preliminary training of boys, while the Sabine, at Portsmouth, N. H., and the Portsmouth, at San Francisco, Cal., which were also engaged on this duty, have been withdrawn, mainly in consequence of the fact that boys did not present themselves at these points in sufficient numbers to justify maintaining them.

The sailing-ship Supply has been employed the past season as tender to the Minnesota, and has made a useful cruise in our own waters, with 125 boys on board.

The Juniata, now replaced by the Monongahela, also made a cruise with her boys to Bermuda, and subsequently spent the summer in Long Island Sound.

In the absence of any positive legislation, the plan adopted is to place these boys for one year under tuition on board of stationary ships, and then transfer them to sea going vessels under the command of officers who will continue their instruction, and give personal supervision to their welfare and advancement.

So far this simple plan has worked satisfactorily, and the boys now in service are already pronounced more valuable to the Navy than the landsmen whose places they occupy.

The Department has directed that the Constitution, at Philadelphia, shall, when ready, go into commission at that port as a stationary training-ship, and the bureau hopes, when opportunity favors, to place the Saratoga at Baltimore for the same purpose.

With these ships thus employed, and with the legislation asked for, and again urged, it is believed that in a very few years a radical and beneficial change will be made in the *personnel* of the Navy.



## TRAINING BOYS FOR ENGINEERS' FORCE.

I consider it practicable and desirable to enlist boys for the engineers' force, under the same system, to become firemen, oilers, and finally machinists if qualified; and I respectfully recommend that it may be tried on board of such of the stationary training-ships as are steamers.

## REDUCTION OF NAVAL FORCE AND ENLISTMENT OF BOYS.

Congress in its last session reduced the force of the fleet from 8,500 to 7,500 men; this reduction places our Navy in its *personnel* below the standard of every navy in Europe, except, perhaps, that of Portugal; its effect, also, upon the service has been injurious by destroying the faith of the enlisted men in the implied promise of the Government to retain them, subject only to their own good conduct, and by forcing them, in the absence of any commerce of our own, to go abroad in search of employment. Many of them, after years of service in which they have become proficient in their duties, are thus lost to the country.

As this reduction, however, has been accomplished, I would recommend that Congress be asked, in lieu of any increase of men in the Navy, for the requisite authority to enlist annually 750 boys in addition to the present force.

The cost of these boys to the pay of the Navy would not amount to more in the aggregate than the cost of 250 men. I ask, therefore, for this moderate addition to the *personnel* of the Navy, in order that the training system now in successful operation, as before stated, may be perfected and made a permanent means of manning the fleet.

## INTEREST ON PAY OF ENLISTED MEN, AND OUTFIT OF CLOTHING.

I would also renew my recommendation of last year, that the provisions of the act of Congress approved May 15, 1872, allowing interest at the rate of 4 per cent. per annum on the savings of soldiers deposited with paymasters, be extended to apply to the amounts due enlisted men in the Navy.

The last annual report of the Secretary of War commends this system of banking in the highest terms, and states that it has been the means in a marked degree of lessening desertion, and thereby increasing the tone and *morale* of the Army. The system is also in operation in the British navy with like gratifying results.

The bureau has for several years endeavored to get a law passed granting to the enlisted men of the Navy an outfit of clothing. Such an allowance would be eminently just, and I therefore again recommend that Congress be asked for the necessary authority.

With the foregoing moderate amount of legislation, and under the constant care and supervision of the Department, I am convinced that the *personnel* of the Navy will be speedily improved, to the great benefit of the country.

Very respectfully, your obedient servant,

R. W. SHUFELDT,  
Chief of Bureau.

Hon. GEO. M. ROBESON,  
Secretary of the Navy, Washington, D. C.

*Estimates of appropriations required for the service of the fiscal year.*

Detailed object of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>SALARIES, BUREAU OF EQUIPMENT AND RECRUITING.</b>		
Chief clerk, per Rev. Stat., page 69, section 416; per act of March 3, 1875, (18 Stats. at L., page 362, section 1;) and per act of August 15, 1876	\$1,800	
One clerk of class four, per Rev. Stat., page 26, section 167; per act of March 3, 1875, (18 Stats. at L., page 362, section 1;) and per act of August 15, 1876	1,800	
One clerk of class three, per act of August 15, 1876	1,600	
Two clerks of class two, per Rev. Stat., page 26, section 167; per act of March 3, 1875, (18 Stats. at L., page 362, section 1;) and per act of August 15, 1876	2,800	
Two clerks of class one, per act of August 15, 1876	2,400	
One messenger, per act of August 15, 1876	840	
One laborer, per act of August 15, 1876	720	
	<u>11,960</u>	<u>\$11,960</u>
<b>CONTINGENT EXPENSES, BUREAU OF EQUIPMENT AND RECRUITING.</b>		
Stationery, books, and miscellaneous items, (appropriated—18 Stats. at L., page 362, section 1;) and per act of August 15, 1876	750	500
<b>PAY OF THE NAVY.</b>		
Pay of commissioned and warrant officers at sea, on shore, on special service, and those on the retired list, and unemployed; for mileage of officers traveling under orders; and for the pay of petty officers, seamen, ordinary seamen, landsmen, and boys, including men for the engineers' force and for the Coast-Survey service, at the pay prescribed by law, as per Rev. Stats., page 249, page 1417; Rev. Stats., page 264, sections 1556, 1595; and by act of June 30, 1876	7,300,000	5,750,000
<b>EQUIPMENT OF VESSELS.</b>		
Coal for steamers' and ships' use, including transportation, storage, and labor; hemp, wire, hides, and other materials for the manufacture of rope; cordage, canvas, leather, and wood; iron for the manufacture of cables, anchors, chains, and galleys; furniture, hose, bake-ovens, cooking and heating stoves, galleys, life-rafts for monitors, tools, condensing and boat-detaching apparatus, heating-apparatus for receiving-ships; and for the payment of labor in equipping vessels and manufacture of articles in the several navy-yards, (appropriated,) as per Rev. Stats., page 738, section 3703, and Rev. Stats., page —, section 3747	1,250,000	970,000
<b>CONTINGENT, BUREAU OF EQUIPMENT AND RECRUITING.</b>		
Expenses of recruiting and fitting up receiving-ships; freight and transportation of stores, transportation of enlisted men, printing, advertising, telegraphing, books and models, stationery, express charges; internal alterations, fixtures, and appliances in the equipment buildings at navy-yards; foreign postage, ferry and car tickets, apprehension of deserters, assistance to vessels in distress, continuous-service certificates and good-conduct badges for enlisted men, and school-books for training-ships, (appropriated,) as per Rev. Stats., page 726, section 3666	95,000	75,000

**No. 6.—BUREAU OF ORDNANCE.****BUREAU OF ORDNANCE, NAVY DEPARTMENT,  
Washington City, October 2, 1876.**

SIR: I have the honor to submit the annual report of this bureau, with accompanying estimates, for the fiscal year ending June 30, 1878.

These estimates are prepared after a careful consideration: First, of the current wants of ordnance, based upon experience, \$289,658; and, secondly, upon repairs necessary to preserve the public property or to

diminish the expense of current work, \$50,154; torpedo service, \$122,763. To which is added an estimate for rifled cannon, including carriages, powder, and projectiles, \$767,000.

#### RIFLE CANNON.

The evident necessity of arming our ships with more efficient guns than the obsolete smooth-bore demanded my attention from my first appointment as Chief of Ordnance. After study of the various systems in use and proposed, I am fully convinced that a breech-loader is best adapted to the conditions of naval warfare, and should be adopted for all new constructions. In this, without regard to real or supposed advantages claimed for breech-loaders, I am mainly governed by the consideration that great length of bore is necessary for an efficient rifle, but as the beam of ships is limited, and the heaviest guns may be carried by quite small vessels when mounted on carriages on the non-recoil system, breech-loading is essential.

Since foreign nations have taken the lead in this subject, and have expended immense sums in experiments, I think it unwise not to take advantage of their experience, and advise that no expense should be incurred in experimenting with new plans unless they offer marked advantages. Both of the successful systems, known as the wedge-breech, or Krupp, and the screw-breech, or French, are of American origin, but owe their development to the efforts of those who have given them common names.

I am of the opinion that the screw-breech is preferable, and have adopted it for the new breech-loading howitzers. Designs are also prepared for every caliber from 3-inch to 12-inch, on this plan, which only await appropriations to begin their manufacture.

I have also converted a Parrott muzzle-loading rifle into a breech-loader, to test the applicability of the system to guns already in the service. This gun, converted by the insertion of a wrought-iron tube from the rear, has, been successfully fired 200 times with service-charges of 10 pounds of powder and 100 pound shells. It will be fired to extreme proof with 15 pounds of powder and shells of same weight.

Eleven XI inch smooth-bore guns of 16,000 pounds have been converted into 8-inch muzzle-loading rifles of 18,000 pounds, for the armament of the United States steamer Trenton, by the insertion of a tube from the muzzle, manufactured at the West Point foundry of Paulding, Kemble & Co.

This construction, correct in theory, has proved eminently successful in practice. A gun of similar proportions lined with an imported tube has been fired by the Army Ordnance over 700 times, with charges and projectiles equal to those used in the English gun of corresponding caliber, (9 ton, 8-inch,) built up of wrought-iron and steel, and the gun yet remains in good condition.

A second gun, with the caliber enlarged to 9 inch, has been fired over 500 rounds, with charges varying from 35 to 45 pounds of powder, and projectiles of 200 to 250 pounds, thus demonstrating the entire safety of the system, although the weight is not sufficient to justify this increase of caliber, weight of charge, and projectile on shipboard.

I did not consider it necessary to duplicate these experiments, at some of which I assisted, and the results of which have been freely communicated to me by General S. V. Benét, Chief of Ordnance, United States Army, but fired the usual proof rounds, satisfied that our own gun-makers produce tubes equal to any imported.

This confidence has been fully justified by the further firing of 500 rounds, from a similar tube made at West Point foundry, at Sandy Hook by the Army Ordnance.

#### GUN-CARRIAGES.

The main battery of the United States steamer Trenton being placed on the gun deck, the regulation-carriage for XI-inch was not suitable for the converted guns. The chief of bureau, with the aid of Commander M. Sicard, then in charge of the ordnance department at Washington, N. Y., devised a carriage with hydraulic recoil check, worked entirely by gearing, and presenting several points differing from any other in use. It works well on a platform, but is yet to be tried experimentally at sea. Wishing to test other plans, I desired the distinguished inventor, Captain Ericsson, to furnish a part of the carriages from his design. They are now ready for delivery.

The safety with which guns of this weight are handled on the regulation carriage shows that mechanical carriages are not necessary; but it is clearly desirable to reduce the number of men required to manage them, that fewer men may be exposed and the ships' crews reduced, or that reliefs may be provided, if an excess is supplied, for the other duties of the ship. It is also certain that the crude methods so long in use for working guns in broadside must give way to improved plans more in consonance with the precision of the guns.

#### RIFLE HOWITZERS.

A battery of twelve breech-loading howitzers, of 350 pounds, has been furnished to the Naval Academy for instruction. Several others are in progress, and they will be issued to ships as fast as limited appropriations will permit. After extended trial the usual serge bag has been adopted for the cartridge. The pieces may, however, be readily adapted to the metallic cartridge should it hereafter be considered preferable. Trial has also been made of a 3-inch steel howitzer, using a metallic cartridge devised by Mr. B. B. Hotchkiss, a well-known inventor in military affairs, for comparison of effect.

#### REVOLVING CANNON.

It is the aim of the bureau to keep pace with all new inventions which promise useful results, and it has, therefore, obtained for trial one of Hotchkiss' revolving cannon, of the class adapted to naval purposes, firing explosive shells of one pound.

The experiments which have been made with this arm in Europe show that it fills a gap between the howitzers and the machine-gun firing small-arm ammunition, especially as a defense against surface torpedo-boats.

#### MACHINE-GUNS.

Machine-guns, whose effects were at first much exaggerated, have now assumed their proper value—a useful adjunct to other arms, but not taking the place of either the howitzer or the rifled small-arm.

They all possess serious defects, and most of the new inventions are in the direction of simplicity and accessibility of the working parts. The value of the gun as a machine consists in the rapidity, simplicity, and certainty of the feed and extraction; as an implement of warfare, on the perfection of the cartridge.

The Gatling gun is in use in the naval service. The Gardner, Bailey, and Lowell battery-guns have been experimented with during the year, with the results reported in appendix. The Lowell battery-gun appears to possess decided advantages over its competitors.

#### SMALL-ARMS.

When the Navy adopted its present arms, in 1869, it conformed to the Army standard, caliber .50; since, the standard has been changed to .45.

It is of great importance that we should have unity of caliber with the sister service in this their special arm, and I recommend an appropriation for transforming our small-arms and machine-guns to that caliber. When the conversion is made, I am decidedly of the opinion that we should adopt a magazine-gun, which, for naval purposes, is in every respect preferable.

#### TORPEDOES.

The torpedo-station, under the charge of Capt. K. R. Breese, assisted by an able corps of officers and professors, continues a career of marked usefulness, and I cannot too strongly recommend liberal appropriations for its support.

While it is true that invention is stimulated by the necessities of war, and actual service the test of efficiency, principles are best studied in the leisure of peace. It requires the combined efforts of the electrician, chemist, and practical officer to devise a system and detect the defects of plausible devices.

Since the school was established, in 1869, one hundred and fifty-three officers of all grades, from captain to ensign, have attended the course of instruction. As the subjects of investigation were in a very chaotic state at its inception, it has advanced slowly and with a very moderate expenditure, until it is now quite complete in all of its departments.

With the exception of the two experts, Prof. Moses G. Farmer, of electricity, and Prof. Walter N. Hill, of chemistry, all the instructors are officers, graduates of the torpedo-school, which, with the ordnance-shops at the Washington navy-yard, may be considered as schools of practice complementary to the Naval Academy course. Valuable practical suggestions are received from graduates in sea-service tending to the improvement of the system, and no difficulty is found in obtaining competent reliefs when the necessity of freshening up their sea-service requires a change in the instructors.

The subject of movable torpedoes has made no progress during the past year. The station Lay and Ericsson torpedoes were sent to the Centennial Exhibition as part of the naval exhibit. Captain Ericsson has improved the simple torpedo of his design, with a view to increase of speed, and further trials will be made in the spring. Mr. Lay offered a second boat for trial, but has not yet succeeded in obtaining a satisfactory speed with his device. I am of the opinion that the ability to direct the course from the shore would not warrant accepting a rate less than twelve knots as a compensation for the great cost and complex nature of this device and appendages. He has not succeeded in obtaining more than one-half that speed.

The fish-torpedo of Whitehead is launched with great accuracy at the rate of eighteen knots in smooth water for a distance of 200 yards, but, from the latest information, it does not appear to be successful at sea.

The development of the locomotive-torpedo is of the highest interest, and as yet we are only groping for a solution.

There has been completed and put in service a fast torpedo-launch, the "Lightning," designed by Mr. J. B. Herreshoff, of Bristol, R. I., under the direction of the bureau, which has made a run of twenty miles in one hour, and for short distances a speed of upward of twenty-two miles, fulfilling all the conditions required.

Some experiments have also been made with a service-launch supplied with a safety-coil boiler and engine adapted to it by the same builder, which uses salt water, makes steam very promptly, weighs very much less than the service fittings, and is entirely safe from damage by the explosion of the torpedo attached to the launch.

Professor Farmer, who has been identified with the electrical attachments for guiding the Lay submerged boat, has also at my suggestion arranged a very compact attachment to be placed in any steam-launch; which, with no alteration in her fittings, starts, stops, steers her, and explodes at will the torpedo attached. This device can be fixed in place or removed in ten minutes, but is very little of an incumbrance if permanently fixed.

#### GUNPOWDER.

The stock of gunpowder has been allowed to fall quite low pending experiments for its improvement; these are now completed, and as the large grain now in use cannot be made with advantage in haste or during the winter months, nor does it damage by keeping, I recommend an appropriation of \$100,000 for the purchase of 4,000 barrels.

#### MAGAZINES.

The naval magazine at Ellis Island, in the harbor of New York, and that at Chelsea, near Boston, should be reduced to places of deposit of ammunition for ships fitting for sea. There has been very much unnecessary inquietude of the public mind, but there is no doubt that they are in dangerous proximity to important interests. It is evidently impossible to remove the reserve stock until some other storage is provided, and it is not probable that a suitable site could be secured and the necessary buildings erected in a safe but easily accessible location for less than \$200,000 for each. I therefore recommend an appropriation of \$400,000 for this purpose.

The improvements at the Norfolk station, for which an appropriation was made last year, are in progress.

#### APPENDIX.

A number of important reports are appended, giving in detail some matters enumerated in the foregoing.

I have the honor to be, very respectfully, your obedient servant,  
WILLIAM N. JEFFERS,  
*Chief of Bureau.*

Hon. GEORGE M. ROBESON,  
*Secretary of the Navy.*

*Estimates of appropriations required for the service of the fiscal year ending June 30, 1878,  
by the Bureau of Ordnance, Navy Department*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>SALARIES.</b>		
Chief clerk, per Rev. Stat., page 70, section 416; and per act of August 15, 1876	\$1,800	.....
Draughtsman, per Rev. Stat., page 70, section 416; and per act of August 15, 1876	1,800	.....
One clerk of class three, per act of August 15, 1876	1,600	.....
Two clerks of class two, per act of August 15, 1876	2,800	.....
One messenger, per act of August 15, 1876	840	.....
One laborer, per act of August 15, 1876	720	.....
	9,560	\$9,560
<b>CONTINGENT EXPENSES.</b>		
Stationery, books, and miscellaneous items, (appropriated,) per act of August 15, 1876	800	400
<b>ORDNANCE AND ORDNANCE STORES.</b>		
Fuel, tools, and material of all kinds necessary in carrying on the current daily work of mechanical branches of the ordnance department of the several navy-yards, magazines, and stations, (appropriated,) per act of June 30, 1876	86,276	50,000
Labor at the several navy-yards, magazines, and stations, in fitting ships for sea, and in preserving ordnance material, (appropriated,) per act of June 30, 1876	180,957	125,000
Miscellaneous items, to wit: Freight to foreign and home stations; advertising and auctioneer's fees; cartage and express-charges; repairs to fire-engines, gas and water pipes; gas and water tax at magazines; toll, ferrage, foreign postage, telegrams, &c. (appropriated,) per act of June 30, 1876	7,425	3,800
NOTE.—The above estimates are based on the experience of several years, and the amounts are necessary for the efficiency of the service		
Experiments in ordnance at naval experimental battery and navy-yard, Washington, (appropriated,) (18 Stats. at L., page 549)	15,000	.....
	289,658	178,000
Necessary repairs to ordnance buildings, gun-parks, magazines, boats, lighters, wharves, machinery, and appendages, including—		
Navy-yard, Portsmouth, N. H.:		
General repairs, (appropriated,) per act of June 30, 1876	1,550	.....
Navy-yard, Boston, Mass.:		
To engines, machinery, &c., (appropriated,) per act of June 30, 1876	500	.....
To ordnance buildings and grounds, (appropriated,) per act of June 30, 1876	2,000	.....
To buildings and grounds at magazine, (appropriated,) per act of June 30, 1876	2,000	.....
Navy-yard, Brooklyn, N. Y.:		
To the ordnance dock, (appropriated,) per act of June 30, 1876	22,258	.....
NOTE.—Attention is called to the absolute necessity for this expenditure at magazine, and for general repairs.	4,060	.....
Navy-yard, Washington, D. C.:		
To gun and shot parks, experimental and saluting batteries, (appropriated,) per act of June 30, 1876	2,500	.....
To engines, machinery, and furnaces, (appropriated,) per act of June 30, 1876	500	.....
To store-house at branch magazine, (appropriated,) per act of June 30, 1876	1,000	.....
Navy-yard, Mare Island, Cal.:		
To buildings, (appropriated,) per act of June 30, 1876	50	.....
To gun and shot racks and grounds, engines, machinery, &c., (appropriated,) per act of June 30, 1876	2,000	.....
To magazine buildings and grounds, (appropriated,) per act of June 30, 1876	1,000	.....
To magazine wharf, (appropriated,) per act of June 30, 1876	1,000	.....
Naval experimental battery, Annapolis, Md.:		
General repairs to buildings, wharf, &c., (appropriated,) per act of June 30, 1876	1,236	.....
	41,654	10,000
NOTE.—For several years the appropriation for repairs has been so much reduced that the buildings and wharves, which are necessarily in exposed situations, are becoming quite dilapidated.		
<b>IMPROVEMENTS AS FOLLOWS, VIZ:</b>		
<i>Navy-yard, Boston, Mass.</i>		
At magazine, Chelsea:		
General repairs, grading and improving the grounds, (submitted)	1,000	.....

*Estimates of appropriations required for the service of the fiscal year, &c.—Continued.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<i>Navy-yard, Mare Island, Cal.</i>		
At magazine :		
Construction of gun-skids and shot-beds, (submitted) .....	\$5,000	.....
Filling and tank-house near magazine for filling powder and shell, and stowing empty tanks, (submitted).....	2,500	.....
	8,500	.....
<b>TORPEDO CORPS.</b>		
Labor, (appropriated,) per act of June 30, 1876 .....	8,000	
Material, (appropriated,) per act of June 30, 1876 .....	1,000	
Coal and gasoline, (appropriated,) per act of June 30, 1876 .....	4,200	
Freight, express charges, postage, &c., (appropriated,) per act of June 30, 1876...	500	
Instruction of officers in electricity, (appropriated,) per act of June 30, 1876 .....	3,500	
Instruction of officers in chemistry and explosives, (appropriated,) per act of June 30, 1876 .....	3,500	
Instruction of officers in torpedoes, (appropriated,) per act of June 30, 1876 .....	500	
NOTE.—The above amounts are based upon simply caring for Government property, receiving and forwarding outfits of ships, &c.		
For general purposes, viz :		
Material .....	\$5,000 00	
Labor .....	10,000 00	
Fuel .....	8,000 00	
Repairs .....	1,000 00	
Sea-wall .....	5,000 00	
	27,000	
Electrical apparatus for instruction in electricity .....	7,245	
Material for electrical department .....	2,050	
Apparatus and material for improvement of torpedoes .....	2,393	
Apparatus and machinery to further develop the application of electricity to purposes of signalling and the lighting of ships .....	6,425	
Chemical apparatus and instruments for instruction .....	12,150	
Instruction in torpedoes, including steel torpedo-launch and general experimental work with torpedoes .....	39,300	
Experiments with submarine projectiles .....	5,000	
	122,763	\$38,500
NOTE.—The above estimates are based upon progressive action, and to enable the Torpedo Corps to attain an advance over other countries, or at least to keep even with them.		
<b>CONTINGENT.</b>		
Contingent expenses of the ordnance service of the Navy, (appropriated,) per act of June 30, 1876 .....	1,000	1,000
<b>ORDNANCE AND AMMUNITION.</b>		
<i>Supplementary.</i>		
For the batteries of ships and as a reserve :		
20 smooth-bore 11-inch guns converted to 8-inch rifles, at \$2,700, (submitted) .....	54,000	
20 carriages for same, at \$3,800, (submitted) .....	76,000	
2,000 projectiles, at \$18, (submitted) .....	36,000	
700 barrels powder, at 30 cents per pound, (submitted) .....	21,000	
For the armament of five double-turreted monitors, viz : Puritan, Monadnock, Miantonomoh, Amphitrite, and Terror :		
20 12-inch rifles, at \$15,000, (submitted) .....	300,000	
20 carriages, at \$6,000, (submitted) .....	120,000	
2,000 projectiles, at \$50, (submitted) .....	100,000	
2,000 barrels powder, at 30 cents per pound, (submitted) .....	60,000	
	767,000	

Respectfully submitted.

WILLIAM N. JEFFERS,  
Chief of Bureau of Ordnance.

BUREAU OF ORDNANCE, NAVY DEPARTMENT,  
October 1, 1876.



UNITED STATES TORPEDO-STATION,  
*Newport, R. I., September 8, 1876.*

SIR: In obedience to the Department's order of the 18th of August, the board met and organized for the purpose of witnessing the examination of the officers under instructions at this place.

The commanding officer, with the instructors and professors of the station, extended us every facility in inspecting the various buildings and the chemical and electrical appliances of the establishment. We take pleasure in saying that everything was found in admirable order and well adapted to the purposes in view.

The examination programme, as submitted by the commanding officer, was not interfered with, except in some minor matters.

We found the class to be proficient in chemistry, electricity, and in all the necessary detail of fitting torpedoes for service, as proved to us by actual experiments.

Each member of the class exhibited a marked cheerfulness in the programme of duty, and a commendable interest in mastering the course laid down for them.

We cannot speak too highly of the great benefit which the station receives, and through it the service, from the valuable experience and able services of the commanding officer and the post-graduate instructors on duty here.

The advantage of the station as a school of special training in a science that is growing daily in its importance as an element of great power in war is manifest. We indulge the hope that its scope of action may be much extended in furthering the great good that the service now realizes from it.

The marked proficiency exhibited by the class of officers after a brief course of three months is an ample argument in favor of the practical advantages of the station, as well as a sufficient assurance to us that all who have been charged with bringing this about have performed that duty with great zeal and to a good purpose.

To continue this good work we would urgently recommend that the tug *Nina*, with her complement of men, be retained here as an indispensable adjunct to the successful accomplishment of the necessary practical work of the station. To withdraw her or her crew at this time would, in our opinion, work with serious disadvantage to the best interest of the station.

We urge also the need of a service steam-launch, fully fitted, as a means toward the fuller development of the object of the institution.

We would add that the facilities of the station for the instruction of officers and men in submarine work are excellent, and we feel that we cannot too strongly urge that the opportunity be seized to furnish the Navy with officers and men trained to operate against submarine defenses or obstructions.

We are, sir, very respectfully,

J. W. NICHOLSON,  
*Commodore, and President of Board.*  
J. C. P. DE KRAFFT,  
*Captain, and Member.*  
R. F. R. LEWIS,  
*Commander, and Member.*  
W. S. SCHLEY,  
*Commander, and Member.*

Commodore W. N. JEFFERS, U. S. N.,  
*Chief Bureau Ordnance, Navy Department, Washington, D. C.*

UNITED STATES TORPEDO-STATION,  
*Newport, R. I., March 18, 1876.*

ASSIGNMENT OF THE OFFICERS OF THE STATION TO DUTY.

Lieut. G. A. Converse, U. S. N., senior assistant inspector of ordnance, instructor in electricity, fuses, and diving.

Lieut. R. B. Bradford, U. S. N., assistant inspector of ordnance, instructor in torpedoes.

Lieut. W. J. Moore, U. S. N., assistant inspector of ordnance, draughtsman, and in charge of drawings, plans, &c.

Lieut. A. E. Coudeu, U. S. N., assistant inspector of ordnance, instructor in electricity.

Gunner Wm. Burditt, U. S. N., in charge of machine-shop.

Prof. M. G. Farmer, electrician.

Prof. W. N. Hill, chemistry and explosives.

Mr. C. A. Pitkin, assistant chemist.

COURSE OF INSTRUCTION.

Embraces the months of June, July, and August.

The attendance of officers for instruction will be from the 9.30 a. m. boat to the 2.20 p. m. boat.

The day is divided into two periods: First period, from 9.45 a. m. to 11.45 a. m.; second period, from 12.15 p. m. to 2.15 p. m.

The following division of time will be observed unless due notice is given of change:

	First period.	Second period.
	9.45 a. m. to 11.45 a. m.	12.15 p. m. to 2.15 p. m.
Mondays .....	Electricity.	Electricity.
Tuesdays .....	Torpedoes.	Chemistry or explosives.
Wednesdays .....	Electricity.	Electricity.
Thursdays .....	Chemistry or explosives.	Torpedoes.
Fridays .....	Torpedoes.	Examination papers.

The principal instructors will assign the whole or part of a class to a period.

The officers under instruction will be divided according to rank in two parts, and be known as the senior half and junior half.

Any change of programme from the established order will be posted in the officers' room at the machine-shop.

Pocket note-books will be furnished the class for daily notes, and a blank-book for each branch of instruction, in which drawings and examinations will be recorded.

Questions bearing upon the lectures for the week will be given out on Friday, and the replies, carefully given and neatly written in the blank-books furnished for the purpose, must be handed in to the commanding officer on Monday.

The books will be examined by the instructors, errors noted, and then returned by the commanding officer with such remarks as may be deemed necessary.

The final examinations will be of a practical character before the board of visitors, and written replies to questions bearing upon the course of

instruction for the term entered in the examination-books, which are to be submitted to the board.

Opportunity will be given to officers to practice in diving and submarine work connected with torpedoes, and at the close of the term such officers as show themselves proficient will receive certificates as divers.

Officers who desire to continue their studies will be (if circumstances permit) allowed to remain, and be attached to the station.

K. R. BREESE,

*Captain, U. S. N., Inspector of Ordnance, in charge of Station.*

Approved :

WILLIAM N. JEFFERS,  
*Chief of Bureau of Ordnance.*

Approved :

GEO. M. ROBESON,  
*Secretary of the Navy.*

#### PROPOSED INSTRUCTION IN TORPEDOES.

Theoretical and practical lectures on Tuesdays.

Practical work on Thursdays.

The work of both days to be interchangeable, so as to avoid bad weather for practical outdoor exercises.

- 1.—Lecture on electricity, Farmer's machines, and fuses, preparatory to outdoor work.
- 2.—Lecture on the history of torpedo-warfare.
- 3.—Lecture on spar torpedo.
- 4.—Same.
- 5.—Same.
- 6.—Lecture on towing torpedo.
- 7.—Same.
- 8.—Movable torpedoes and torpedo-boats.
- 9.—Same.
- 10.—Same.
- 11.—Lecture on submarine guns and rockets.
- 12.—Lecture on ground torpedoes.

The practical work to follow the lectures, and on the same subjects, excepting that of the 2d lecture, as near as practicable depending upon progress made and means at hand for experiments.

#### PROGRAMME OF LECTURES FOR INSTRUCTIONS IN ELECTRICITY.

- 1.—Galvanic batteries: simple galvanic, describing action, &c.; different forms in use; chemical action, &c.; definition of electrical current; resistance, and other terms in common use.
- 2.—Measurements of currents, describing galvanometers.
- 3.—Law governing electrical resistance; branch currents.
- 4.—General electrical measurements of resistance and electro-motive force.
- A.—Effects of currents, heating.
- 5.—Arrangement of batteries for particular work.
- 6.—Magnets and magnetism.
- 7.—Ampère's theory of magnets and electro-magnets.
- 8.—Magneto-electric and dynamo-electric induction.
- 9.—Farmer's A machine.
- 10.—Farmer's C machine.

- 11, 12, 13.—Siemen's, Wilde's, and Wheatstone's machines for torpedo purposes, Beardslee's, Breguet's, Gramme's.
- 14.—Fuses: description of different fuses, their advantages and disadvantages.
- 15.—Comparison of galvanic batteries and electrical machines; under what circumstances each is advantageous; batteries for ship use.
- 16.—Frictional electricity and Smith's machines.
- 17.—Electrical apparatus for Lay's boat.
- 18.—Telemeter: Siemen's distance measurer.

*By Professor Farmer.*

- |                     |                              |
|---------------------|------------------------------|
| 1.—Potential.       | 5.—Magnetic engines.         |
| 2.—Branch currents. | 6.—Magneto-electro machines. |
| 3.—Fuses.           | 7.—Electric lights.          |
| 4.—Batteries.       | 8.—Cables.                   |

*By Lieutenant Converse.*

- 1.—The indicator.
- 2.—Circuit buoys.

PROGRAMME OF PRACTICAL WORK IN ELECTRICAL COURSE.

- 1.—Setting up galvanic batteries and electrical arrangements of building, lead of wires, &c.
- 2.—Same.
- 3.—Use of galvanometers.
- 4.—Measurement of resistance and electro-motive force.
- 5.—Same.
- 6.—Measurements of insulation, half of class.  
Fuse-making, half of class.
- 7.—Same for opposite halves of class.
- 8.—Resistances of wires about the island, half of class.  
Fuse-making, half of class.
- 9.—Same.
- 10.—Measurements of current required for firing fuses of different material and various patterns, half of class.  
Fuse-making, half of class.
- 11.—Same.
- 12.—Same.
- 13.—Same.
- 14.—Measurement of electro-motive force and resistance of Farmer's machines, half of class.  
Fuse-making, half of class.
- 15.—Same.
- 16.—Measurement of batteries before and after being on short circuit, half of class.  
Fuse-making, half of class.
- 17.—Same.
- 18.—Measurement of insulation of different splicing unions, half of class.  
Fuse-making, half of class.
- 19.—Same.

CHEMISTRY.

*Course of instruction.*

Instruction given under two heads, viz: Chemistry proper, and explosives; each treated by weekly lectures. Topics to be discussed will be taken up in nearly the following order, and in the course thirteen lectures will be delivered.

*Chemistry.*

- 1.—Introductory and general. Most important principles of chemistry. Chemical language.
  - 2.—Oxygen: Air.
  - 3.—Hydrogen, water; nitrogen—ammonia; oxides of nitrogen.
  - 4.—Fluorine, chlorine, bromine, and iodine.
  - 5.—Sulphur.
  - 6.—Phosphorus, arsenic, antimony.
  - 7 and 8.—Carbon and silicon. Organic chemistry.
  - 9.—Potassium, sodium, calcium, and magnesium.
  - 10.—Zinc, manganese, and aluminum.
  - 11.—Iron.
  - 12.—Copper, lead, and tin.
  - 13.—Mercury, silver, gold, and platinum.
- Related subjects will be placed under most appropriate heads.  
Lectures will be accompanied by experiments and diagrams projected by calcium light.

*Explosives.*

- 1.—General explosive reactions and effect. Circumstances of explosion and mode of firing.
- 2.—General condition, detonation, mode of producing detonation, composition of explosive bodies, explosive mixtures and compounds.
- 3, 4 and 5.—Gunpowder; composition and relations; manufacture; varieties; results of explosion.
- 6 and 7.—Nitro-glycerine and nitro-glycerine mixtures.
- 8 and 9.—Gun-cotton and gun-cotton mixtures.
- 10.—Picrates; picrate powder; fulminates.
- 11.—Explosive mixtures other than gunpowder.
- 12.—Applications of explosives to torpedo purposes.

The thirteenth lecture is omitted here, but will be devoted to either a review or to subjects omitted previously. This course has usually consisted of more than thirteen lectures, so it will be crowded.

Lectures will be illustrated by figures and diagrams by the lantern.

*Practical work.*

Process of making nitro-glycerine, dynamite, and long-stapled gun-cotton; experiments with explosives.

At times to be appointed by commanding-officer.

## EXAMINATION QUESTIONS IN TORPEDOES.

- 1.—Explain the different types of torpedoes in use. What types are used in the naval service, and what torpedoes and torpedo supplies are furnished to cruising-ships?
- 2.—Describe the service spar-torpedoes, the different kinds, their construction, capacity, mode of filling, firing, kind of powder used, and give directions for preparing them for service. Give immersion necessary for the best effect, and immersion and distance necessary for safety when exercising.
- 3.—Describe service-spars for ship and boat use, giving dimensions, material, rigging, and attachments, mode of handling, number used, and how and where secured.

- 4.—Describe the manner of exploding spar-torpedoes, and all the gear used for that purpose, including the practical use of machines, batteries, firing key, key-board, electric switches, insulated wire, and terminal binding-screws. Where these articles are placed when in use, and where when not in use. Where are the permanent wires, electric switches, and terminal binding screws placed, how secured, and how preserved from injury?
- 5.—Describe the service towing torpedo, its construction, capacity, mode of filling when preparing for service, construction of firing apparatus, and method of igniting the charge.
- 6.—Describe all the various attachments of the service towing torpedo, how used, where placed, and prepare the torpedo for service and exercise.
- 7.—How launch the service towing torpedo, and how handle it after it is launched. Tactics to be observed in maneuvering with it for attack and defense.
- 8.—Describe the Lay torpedo and all its attachments. Give range, speed, mode of working, and prepare it for service.
- 9.—Describe the Ericsson torpedo and all its attachments. Give range, speed, and mode of working.
- 10.—Describe the Whitehead torpedo, so far as known. Give range, speed, accuracy, and probable use.
- 11.—Describe in a general manner how to defend vessels of war against torpedo-attacks of all kinds.
- 12.—General discussion of the subject of ground-torpedoes. Their object, different classes, and how used. How operated against.

#### QUESTIONS IN ELECTRICITY AND FUSES.

- 1.—Describe the construction and action of a simple voltaic circle.
- 2.—Describe the construction and action of a sulphate of copper battery with and without a porous cup.
- 3.—Describe the bichromate of potash battery, station-form.
- 4.—Describe the Leclanché battery.
- 5.—Give the general formulas for current electricity based on Ohm's laws, showing the relations that subsist between electro-motive force, resistance, current, quantity, and work done.
- 6.—What are the electrical dimensions of a source of electricity?
- 7.—Compare the foregoing batteries and give their relative merits for different purposes, both on board ship and on shore.
- 8.—Having a given external resistance,  $R$ , how would you arrange  $U$  cells so as to exert in the resistance  $R$  the greatest energy per minute?
- 9.—Describe the construction and mode of operating Farmer's dynamo-electric machines, types A and C, and contrast their serviceableness with the before-mentioned forms of galvanic battery.
- 10.—What can be accomplished by the use of the machines above named in firing torpedoes?
- 11.—What abuses will they withstand, and what care should be taken of them?
- 12.—What kind of igniters or fuses are best adapted to be used with these machines, and why?
- 13.—Having a number,  $P$ , of fuses, how is it best to couple them so as to insure the simultaneous ignition of them all with a given and adequate E M F and internal resistance?
- 14.—Wishing a fuse to be used with a voltaic battery or dynamo-electric

machine, what would guide you in the selection of material for bridge?

- 15.—Having suitable materials, describe process of making up an igniter for torpedo purposes. Give reasons, if any, for changing form or details of present service igniters.
- 16.—In improvising a metallic bridge igniter, what materials obtainable on board ship can be used? How would you determine the length of bridge for any such material?

#### EXAMINATION QUESTIONS IN CHEMISTRY.

- 1.—Explosive reaction and explosive effect.
- 2.—General composition of explosive bodies.
- 3.—Difference between explosive compounds and explosive mixtures. Classes of explosive mixtures compared.
- 4.—Detonation: Comparative value of a detonating explosion.
- 5.—Effect of circumstances on explosive results.
- 6.—Gunpowder: Manufacturing process; general composition; effect of mechanical variations on explosive properties of gunpowder.
- 7.—Preparation of nitro-glycerine: Precautions to be taken; composition of nitro-glycerine, and the chemical character of the reaction by which it is produced: properties of nitro-glycerine; its advantages and defects.
- 8.—Dynamite: Preparation, properties, advantages, and defects; precautions to be taken in storage, transportation, and use; mode of using, firing, &c.; safety.
- 9.—Carrying dynamite on board ship.
- 10.—Gun-cotton: Composition, preparation, and properties; reaction by which it is produced; forms in which it is prepared for use.
- 11.—Fulminating mercury: Preparation, uses, and mode of handling.
- 12.—Picric acid and the picrates; picrate mixtures.
- 13.—Modes of handling, using, and firing the practical explosives.
- 14.—Firing-points of explosives.
- 15.—Composition of explosive agents for torpedo purposes: Force, safety, convenience, ease of obtaining, &c.
- 16.—Sizes of charges for torpedoes, and effects obtained.

#### TORPEDOES.

##### *Programme of practical work before board of visitors.*

- 1.—The class to go out in the Nina and explode two 100 pounders. One with machine and service-fittings, and the other with voltaic battery. One division to each torpedo, and to do all the work themselves.
- 2.—To exercise with the Harvey torpedo; to rig it with an exercise-bolt and capsule; launch it and manage everything themselves; to chase and attack the Joseph Henry, if weather permits.
- 3.—Each division to fit and explode two 75-pounders from launches Nos. 2 and 3.
- 4.—Each division to fit and explode simultaneously 12 can-torpedoes, using an A machine to illustrate the method of destroying sunken obstructions.
- 5.—Each division to plant one torpedo of convenient size, connect it with a circuit-closer, and then explode it by bumping the circuit-closer, to illustrate the ground-torpedo.
- 6.—To run the torpedo-launch Lightning, with her torpedo-gear and electric light.

## PRACTICAL WORK IN FUSES.

Each officer to explode wooden case and improvised igniters made by himself; results to be recorded.

## PRACTICAL WORK IN ELECTRICITY.

Have A and C machines, two earth-plates, 60 feet naked copper wire, No. 16; igniters to be fired.

- 1.—A machine, broken circuit inside; to find fault and put in order.
- 2.—C machine, hammer not striking bell; to find fault and put in order.
- 3.—Earth not complete, insulation not removed from wire; discover fault and remedy it.
- 4.—Fire igniter through two wires, 30 feet each, uninsulated submerged copper wire, A machine. Fire igniter through two wires, 20 feet each, uninsulated submerged copper, C machine.
- 5.—Fire six igniters, naked joints, submerged in sea-water.
- 6.—Fire ten igniters in series A machine.

## ORDER OF EXAMINATION.

*Tuesday, September 5, 1876.*

The officers under instruction, for convenience sake in examination, will be arranged in three divisions, as follows:

First division.	Second division.	Third division.
<b>TORPEDO-ROOM.</b>	<b>CHEMICAL LABORATORY.</b>	<b>ELECTRICAL LABORATORY.</b>
Lieutenant-Com. Cotton. Lieutenant-Com. Whiting. Lieutenant Noel. Lieutenant Chipp. Lieutenant Buckingham. Lieutenant Berry. Master Calhoun.	Lieutenant-Com. Tracy. Lieutenant-Com. O'Neil. Lieutenant Newell. Lieutenant Irvine. Lieutenant Paine. Master Rohrer. Master Busbee.	Lieutenant-Com. Clark. Lieutenant Anthony. Lieutenant Sturdy. Lieutenant Lee. Lieutenant Bassett. Master Mahan.

*Tuesday* morning, immediately after the reception of the board of visitors, examination in chemistry and explosives.

*Wednesday* morning, at 9.45 a. m., examination in electricity and fuses.

*Thursday* morning, at 9.45 a. m., examination in torpedoes.

*Friday* morning, at 9.45 a. m., practical work.

Questions will be found in each of the above rooms, to which written replies are to be given, and, as soon as completed, they will be handed in to the clerk to the commanding-officer.

Any change in the above programme will be duly promulgated.

K. R. BREESE,

*Captain U. S. N., Inspector Ordnance, in charge of Station.*

## REPORT OF PROFESSOR FARMER, ELECTRICIAN.

The course of instruction in electricity having been completed, I have to report that the course, as laid down at the commencement, has been followed.



The course has been of a practical nature, its object being to show the effects of electricity, and the manner of producing these effects. Attention has been confined, as regards sources, to the voltaic battery and induction-machines. The different methods of measuring the value of these sources under different circumstances, and the care necessary for preservation, economy, and maximum effect, have occupied much of the time.

The course was intended to teach the officers to handle electrical apparatus intelligently under any circumstances, especial attention being directed to the firing and testing of torpedoes and to lighting and signaling.

Among other subjects, my lectures to the class embraced the following: "History and progress of electricity for two hundred years past."

Lectures on "computation of resistances."

"Meaning of different electrical terms, as quantity, Farad, Weber, &c."

"Resistances of bodies."

"Electrical resistances and potential."

"History of D. E. machines."

"Comparison between galvanic batteries and machines for ships' use."

"Electric lights."

"Telegraphs, simple, duplex, counter-duplex, quadruplex, boat-steering apparatus," &c.

#### REPORT OF INSTRUCTION IN ELECTRICITY, FUSES, AND DIVING, BY LIEUTENANT CONVERSE.

The course of instruction as above having been completed, I have to report as follows:

##### *Electricity.*

August 30, delivered a lecture on "The various methods of determining the position of a ship with reference to any individual torpedo, or group of torpedoes, in a defensive system, and the electrical apparatus used for testing and firing such torpedoes."

Explained the methods of determining the position of a ship by cross-bearings, use of plane-table, electric position-indicator, and camera-obscura. The use of testing and firing apparatus for systems of this kind.

September 4, lectured on same subject; explained use of circuit-closer, circuit-breaker, and circuit-shunts; exhibited and explained the English shutter-apparatus and the circuit-indicator used at this station.

##### *Fuses.*

As it was deemed best for the officers under instruction to have a general knowledge of electricity and the effects of electrical currents before commencing the manufacture of fuses, the instruction in this branch was not commenced until 26th June. From that date until the close of the course instruction has been given twice a week, on Mondays and Wednesdays, half of the officers being present on each day. By this arrangement each person has had twenty hours' practical work in the fuse-room.

Each officer was required to make the following fuses:

Five wooden-case igniters, D. E. 3.

Five copper-case igniters, D. E. 7.

Five service-fuses.

Three improvised wire-bridge igniters.

Three improvised tin-foil-bridge igniters.

One improvised igniter, Bradford's pattern.

One improvised igniter, Barber's pattern.

One improvised igniter, Moore's pattern.

One improvised igniter, original.

During the examination the officers have been required to explode all the wooden-case D. E. 3 and improvised igniters. Results were quite satisfactory, showing that the igniters had, with few exceptions, been carefully and skillfully made.

### *Diving.*

Owing to the failure to secure suitable men to be trained as divers, no instruction has been given in this branch.

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### REPORT OF LIEUT. A. E. COUDEN, INSTRUCTOR IN ELECTRICITY.

The course of instruction in the electrical department being completed, the following report of instruction is submitted:

Lectures have been delivered on the following topics:

1. Galvanic batteries.
2. Laws of electric currents and resistance.
3. Laws of electric resistance, continued, and methods of measuring it.
4. Laws of electric resistance, and methods of measuring it, continued.
5. Laws of electric resistance and methods of measuring, continued.
6. Methods of arranging batteries for different purposes.
7. Methods of arranging batteries for different purposes, continued.
- Heating effects of currents.
8. Magnets and magnetism.
9. Magnets and magnetism, continued.
10. Electro-magnetic induction.
11. Wilde's small machine.
12. Farmer's D. E. machine, pattern A.
13. Farmer's D. E. machines, A and C.
14. Siemens' machine; comparison with Farmer's.
15. Beardslee's, Wheatstone's, Breguet's, and Gramme's machines.
16. Smith's frictional machine.
17. Relative value of dynamo electric machines and galvanic batteries for use in torpedo-operations on board ships and in boats.
18. Same, continued.
19. Insulation of conductors.
20. Electrical apparatus of Lay boat.
21. Electrical units, reasons for adoption of units used.

The course of lectures has been supplemented by a course of practical work, occupying four hours per week. This work has consisted in setting up different batteries and noting their action, using the various instruments and methods in measuring resistance, insulation and electromotive and resistance of different batteries and machines; calculation of resistance from dimensions and quality of conductors; calculation of

number and arrangements of battery-cells necessary to perform certain work, some for machines, and the converse—i. e., having a certain source of electricity, what work can it do? practical test of such calculation; testing cables for insulation; discovering faults in machines purposely out of order, and repairing such faults; testing capacity of machines to fire through uninsulated wire; testing effect of salt-water on machines; measurement of current necessary to heat five wires of different material to firing-point of different priming-material, and other work of the same nature.

#### REPORT OF PROF. W. N. HILL, INSTRUCTOR IN CHEMISTRY AND EXPLOSIVES.

The course of instruction in the chemical department for the past three months has been carried on under two heads, chemistry and explosives. One course of weekly lectures on chemistry, and another on explosives, have been delivered.

The object of the chemical lectures has been the study of the most important and common elements and their principal compounds, with especial reference to technical methods and processes. I have not desired to enter deeply into theoretical chemistry, but rather preferred to discuss practical applications of chemistry in the arts. Particular chemical principles have been sufficiently taught in order to demonstrate the chemistry of explosives, a subject fully treated in the other courses.

Thirteen (13) lectures on chemistry have been given. Below will be found a list showing the subject of each, from which an idea of the course may be derived.

These lectures have been illustrated as fully as has been possible with the means at my disposal, by experiments and by sketches, drawings, &c., projected upon the screen by the calcium light.

#### *Subjects of the lectures on chemistry.*

1. Chemical principles, formulæ, and equations.
2. Oxygen: oxidation, the atmosphere, relations of the gases of the air to animal and vegetable life.
3. Oxygen concluded: ozone. Hydrogen: water; natural waters, and the impurities found in them.
4. Natural waters concluded. Nitrogen and oxides of nitrogen.
5. Nitric acid. Acids, bases, and salts. Compound radicals.
6. Ammonia. Fluorine and chlorine. Etching and bleaching.
7. Oxides of chlorine. Bleaching-powder. Bromine and iodine.
8. Sulphur: manufacture of oil of vitriol.
9. Sulphuric acid concluded. Phosphorus, manufacture and use of.
10. Antimony and arsenic, silicon and silicates, glass.
11. Carbons: oxides of carbon; liquid carbonic acid.
12. Carbon concluded. Iron and iron smelting.
13. Metallurgy of iron concluded; cast and soft irons; steel and Bessemer steel.

In the lecture on explosives, I have discussed explosive action and effect, generally considered, and the composition, preparation, and use of explosive agents, with especial reference to their application to torpedoes.

These lectures have been illustrated by drawings, figures, &c., of apparatus and machinery projected upon the screen.

The scope of this course will be seen from the following list of subjects of the lectures.

Twelve (12) lectures have been delivered.

*Subjects of the lectures on explosives.*

1. Explosive reactions; cause of the *explosive* character of a chemical reaction; influence of the time of an *explosive* reaction on the effect obtained. Detonation.
2. Comparative value of detonation. General composition of explosive bodies. Explosive mixtures. Classes of gunpowder begun.
3. Gunpowder. Natural and artificial production of saltpeter; refining saltpeter.
4. Gunpowder continued. Refining sulphur; preparation of the charcoal. Dry mixing. Stamp and wheel mills.
5. Gunpowder continued. Pressing, granulating, and drying powder. Tests of gunpowder. Products of explosion. Temperature. Pressure and work of explosion.
6. Gunpowder concluded. Effect of physical and mechanical condition of gunpowder on its explosion. Varieties of gunpowder. Chlorate mixtures.
7. Nitro-glycerine. Constitution and properties; materials for making; process of manufacture.
8. Nitro-glycerine continued. Mode of firing. Storage. Transportation and handling. Use and relative force. Products of decomposition.
9. Nitro-glycerine concluded. Dynamite. Other nitro-glycerine preparations.
10. Gun-cotton. Composition, preparation, and properties. Forms, uses, and force. Products of decomposition.
11. Picric acid. Constitution. Picrates and picric powder. Fulminating mercury.
12. Fulminating mercury concluded. Fulminating silver. Chloride, bromide, and iodide of nitrogen. Fuse-mixtures. Explosives in torpedoes.

The officers under instruction have received copies of the Notes on Explosives, the pamphlet published by the Bureau of Ordnance, which was originally drawn almost entire from the notes of this course of lectures as delivered in 1874-'75. As they were to have this work, I have made these lectures, this time, as far as possible, supplemental and additional to it, so that with it and their notes taken in the lecture-room they might have a pretty general and complete view of the subject.

In addition, the process of making nitro glycerine and dynamite have been performed before them and with their assistance, and the properties of these agents experimentally demonstrated.

The officers under instruction have been required to take full notes of the lectures. Each week a series of questions on topics covering the week's instruction has been posted, and they have been required to answer these questions in the books furnished for the purpose and hand in these books for examination. I have regularly examined and corrected their books each week, reporting to that effect.

I think, therefore, that the course of instruction directed has been carried out quite fully.

The officers under instruction have been attentive and interested in their work, and have, in general, performed it in a very satisfactory manner.

## REPORT OF LIEUT. E. B. BRADFORD, INSTRUCTOR IN TORPEDOES.

The course of instruction in torpedoes just completed has embraced seventeen (17) lectures of two hours each, and ten periods of practical work.

The lectures were on the following topics, and given in the order mentioned:

1. One lecture on the sources of electricity for exploding torpedoes, use of machines and batteries and mode of fitting and exploding fuses and exercise torpedoes, preparatory for out-door practical work. Illustrated with blackboard sketches and experiments.

2. One lecture on the history of torpedo warfare. Illustrated.

3. Five lectures on the spar-torpedo. These included a general description of the use of this type of torpedo from its commencement up to the present time, a full description of all service material and supplies connected with the spar-torpedo as now used in the different classes of vessels in the Navy, and proposed improvements that might hereafter be introduced. Illustrated with many scale drawings, blackboard sketches, and models.

4. Four lectures on the subject of towing-torpedoes. These included a complete description of the various kinds of towing-torpedoes that have been used at this station, a detailed account of the present service pattern, with all its attachments, and the manner of using it offensively and defensively; also, a brief description of towing-torpedoes used in other countries, and the desirable qualities of a torpedo of this type. Illustrated with many drawings, sketches, and, as far as possible, with the service articles themselves.

5. Four lectures on the subject of movable torpedoes. These included full description of the Lay and Ericsson torpedoes, and of the Whitehead, so far as is known by our Government. Numerous other torpedoes and torpedo-boats of lesser note of this type were also described. Illustrated with drawings.

6. One lecture on submarine projectiles and rockets and ground-torpedoes. These subjects were treated of in a general manner, owing to the very limited time devoted to them. Illustrated with drawings and sketches.

7. One lecture on operations against ground-torpedoes and defense of ships against torpedo-attacks.

The note-books of the class 8" x 10" will average 150 pages of notes and drawings taken from the above lectures. Many of the books contain more.

The practical work of the course was arranged as far as possible to illustrate the various subjects treated of in the lectures. It embraced ten periods (half days) and was arranged as follows:

1. Two periods. Fitting and exploding exercise torpedoes from boat-spars, using service machines and material.

2. One period. Fitting and exploding service-boat torpedoes from steam-launch.

3. Three periods. Exercising with service ship torpedoes, spars, machines, voltaic batteries, key-board, electric switches, permanent wires, and all other service material connected with the spar-torpedo on board of the Nina.

4. One period. Engaged in making improvised torpedoes and exploding 25-pound dynamite torpedoes from service-launch.

5. Three periods. Exercising with the service towing torpedo, towed by the Nina, using the schooner Joseph Henry as a target.

The use of the movable torpedoes belonging to the station could not be illustrated to the class, owing to their absence.

#### TORPEDO-STATION

*Newport, R. I., November 25, 1876.*

SIR: I respectfully submit the following general report of the condition of the station, of the work done, in progress, and in contemplation, together with the reports of Professor Farmer and Professor Hill, in their respective departments, and a paper on torpedoes, by Lieutenant Bradford, United States Navy.

Respectfully, your obedient servant,

K. R. BREESE,

*Captain U. S. Navy, Inspector of Ordnance in Charge.*

Capt. WILLIAM N. JEFFERS, *U. S. Navy,*

*Chief of Bureau of Ordnance, Washington, D. C.*

#### *Buildings.*

Office-building.—The south end of this building is used for quarters for the inspector of ordnance in charge, and the north end for offices, library, draughting-room, and torpedo-lecture room. It is in fair condition, but, in common with all the buildings on the island, needs painting very much.

Six cottages, comprising the quarters of three assistants to the inspector in charge, the chemist, the electrician, and the gunner in charge of the machine-shop, are in fair condition, but particularly needing painting, and in some places replumbing.

The chemical laboratory building is in good condition, and embraces, with its small amount of chemical apparatus, an ample lecture-room for the instruction of officers. Additional apparatus and facilities are required for this building, which have been estimated for.

A windmill in the yard to this building, erected over an artesian well, with a pump attached, has saved much labor in supplying water for the nitro-glycerine building and its attachments, and has also been made use of to supply the boiler to the machine-shop and the steam-launches. A reservoir in connection with this mill is much needed to store up water in the event of calms or drought, and an estimate is presented therefor.

The buildings for the manufacture of nitro-glycerine, gun-cotton, carbonic-acid gas, &c., are of a temporary character, and of sufficient means for experimental purposes.

The small magazines for the storage of small quantities of nitro-glycerine and other explosives collapsed this spring, as reported, and the two new ones authorized by the bureau have been completed, and are now in use. Two more of the same character are required, and are embraced in the estimates. As only 50 pounds of nitro-glycerine or its compounds can be kept on the island, it is desirable that suitable places should be prepared on Rose Island for the care and preservation of the main store of such matter. Authority for this has been kindly granted by General Warren, United States Engineers, in charge, and proper receptacles from the old casemates can be made at small expense. An estimate for this is also submitted.

The electrical building is in excellent order, but needs enlargement and much additional apparatus, which has been estimated for, and is embraced in the estimates submitted to the bureau.

The store-house is ample for present needs, and is in excellent condition.

The machine-shop is in good condition, and its capacity is sufficient for the wants of the station, aided, as it may be, by the manufacturing establishments of Newport and Providence. The blacksmith-shop I would recommend to be removed to the outside of the building adjoining, and its room given to the main shop as an assembling room for manufactured articles, which is much needed.

The steam fire-engine is placed near the coal-shed and is fed from the harbor. At low-water it can only draw from its reservoir—a hole dug around the suction—and which could hardly supply a half-hour's demand. I would recommend that it should be moved away from all buildings, and to a position where it could take its supply from deep water and independent of the tides. The cost of this is also estimated for.

The men's quarters have been fitted up from the old machine-shop, and will comfortably accommodate the service-men intended by the bureau to be kept here for instruction in submarine work.

The stable is ample and in good condition, but would be much improved by raising about six feet.

The coal, coming under the cognizance of the Bureau of Equipment, has been lying on the bank and rather scattered, on account of the cost involved in piling. To remedy this, a place has been partially prepared to receive all further supplies, and a small expense will adapt it to all the requirements of the future.

I would recommend particularly to you the construction of a room for the instruction of officers in torpedoes, and large enough to embrace a collection of material necessary to exemplify the lectures. Also, a permanent boat-house or shed sufficiently large to cover all the boats hauled up for the winter.

There have been constructed, under the orders of the bureau, the following outhouses and sheds:

Two small outhouses in laboratory-yard for holding different chemicals not desirable to keep in the main building, and for the care of fuses, igniters, &c. They are sufficient for their purpose.

A filling-house at the junction of the wharf with the island, for the reception and filling of torpedoes used in practice, supplies a hitherto much-needed want.

A boat-shed on the wharf for the reception of oars, buoys, lines, grappels, &c., together with torpedo-fittings for boats, has been of great service, by having a place for such things and for their better care.

A boat-house built expressly for two Lay torpedo-boats, and with means to successfully work them therefrom without regard to tide.

The old Lay boat-house, of a very frail character, after having blown down once, has been sufficiently strengthened to answer temporarily as a lime-house and paint-shop.

The powder-magazine is in excellent condition, and of ample capacity for the wants of the station.

In obedience to the bureau's directions, the "torpedo instructions" have been prepared by the naval officers attached to the station and submitted to the bureau for approval.

There are under consideration for dissemination in the service, by orders of the bureau, the subjects of—

Defense by torpedoes.

Attack against torpedoes.

Offensive use of torpedoes.

Instruction to divers.

Submarine work.

*Torpedo fittings for boats.*

An improvement by Lieutenant Converse, U. S. N., over the service-fittings for boats, has been sufficiently experimented with to warrant its attachment to the service-launch Success. It is intended to use the torpedo ahead or abeam at pleasure from the same spar.

The fittings for the Lightning were described at length in the report upon that boat.

*Steam-launches.*

Steam-launch No. 1 (Billow) is in use as a ferry-launch, is in good condition, runs economically, and is admirably adapted for her purpose.

Steam-launch No. 2 (Wave) is used for torpedo experiments; is old, in not very good condition, nor is it well adapted for torpedo purposes. It answers very well as a relief boat to the ferry-launch.

Steam-launch No. 3, (Ripple,) experimental launch, is now fitted with a propeller designed by Lieutenant Barber, U. S. N. This boat was in use by the frigate Congress until sunk in the North River, where it lay for seven months; and, as may be supposed, is not now in first-rate condition, and is only useful as a boarding-boat to men-of-war on their arrival and for the exchange of officers' visits.

Steam-launch No. 4 (Fowler) has just been returned to the station, after an absence of about two years. This boat was long experimented with with the Fowler wheel, but is now returned with the Mallory wheel. The hull only of this boat, which is of steel, is in good condition.

Steam-launch No. 5 (Success) is an English built so-called life-boat launch; is in excellent condition, being fitted with Herreshoff's boiler and engines. This launch is fitted for torpedo purposes as a service-launch.

Steam-launch No. 6 (Lightning) has already been described.

Rowing-launch No. 1 is the Niagara's old launch; is in good condition, and answers admirably its purposes as a freight-boat, planting torpedoes and circuit-closers, laying electric cables, splicing, &c.

Rowing launch No. 2 is fitted and used solely for class instruction in torpedoes.

Rowing launch No. 3 is fitted as a torpedo-launch for class instruction, and particularly as a diver's boat for submarine work.

Two small pulling boats for general purposes, in good condition.

The schooner Joseph Henry, purchased from the Coast Survey for experimental purposes, (blowing up,) has been found to be well suited as a moving target for practice with towing-torpedoes, and is now retained for that purpose.

The iron caisson, for experiment with submarine projectiles, is in excellent condition, and much is hoped from it when enabled to proceed with work.

*Lay torpedo-boat.*

New flasks having been made for the Lay torpedo-boat, for the instruction of the class, Lieut. R. B. Bradford, U. S. N., was directed to get the boat in working order, and after much patient and wearying labor he got the boat into excellent working condition, and I have been assured by all who have had the power to compare that it worked better than ever.

Improvements in this boat were suggested to me by different officers of the station, and, upon representation to the bureau, authority was granted to alter the Lay boat according to the plans suggested. Before



work could be commenced this authority was revoked, and the announcement made that the bureau had agreed to purchase a new Lay torpedo-boat, if upon trial it came up to certain conditions. This new Lay torpedo-boat was brought here by Mr. Lay, and it became evident that it could never reach the required speed in its then condition, and a critical examination failed to make its advantages apparent, over what it was conceived in the minds of the officers of the station the old boat was susceptible of becoming, except in point of size. No official trial was held, but all the trials were witnessed by more or less of the officers of the station. The boat was finally removed to Washington by Mr. Lay, upon the authority of the bureau, granted at his request.

#### *The Ericsson torpedo.*

The trials of the Ericsson torpedo were brought to a successful conclusion, detailed reports of which were submitted to the bureau.

#### *Towing torpedoes.*

Experiment has been conducted on the towing-torpedo designed by Lieutenant Barber, U. S. Navy, and upon that of Lieutenant Maynard, U. S. Navy, but from want of facilities experiment has ceased.

#### *The tug Nina.*

The Nina, fitted and used as a torpedo-vessel, has been attached to the station almost since its foundation, and with her crew has been an essential feature of the station. Without this vessel or an equivalent much interesting experiment must be wholly stopped, and an essential feature of instruction of officers given up. By means of this vessel great improvements in rigging and carrying the torpedo-spars have been successfully carried out, and a spar designed by Lieutenant Bradford has been made, so far, to answer the requirements of a torpedo-spar for ships. As the present torpedo was designed to be used ahead, and as it is becoming general to carry them abeam, a change in the design and manufacture would seem desirable, and should be experimented upon with a view of substituting new ones for those now in use. Experiments upon the lead of wires and the uses of voltaic batteries have also been made from the Nina, under Lieutenant Bradford, most successfully.

It is hoped that the requirements of the general service will not be such as to deprive the station of the very great advantages of having permanently attached to it the Nina or other proper vessel with a liberal crew.

I beg leave to refer the bureau to the letter to me from Lieutenant Bradford, accompanying this, as from an accomplished officer who has given the subject of torpedoes much thought. This letter gives in a general way the work on torpedoes that has taken place at the station, as well as the views of the writer.

The station is much indebted to the advice and work and instruction of its distinguished electrician, Prof. Moses G. Farmer, and the wise provision of the bureau in retaining him in a more permanent character has already been felt. I beg leave to refer you to his report to me, accompanying this, which gives much of the work which has been done by the electrical department of the station.

Prof. Walter N. Hill has been connected with the station since its foundation, and continues his career of usefulness in the department

of chemistry and explosives. Mr. Hill's report to me embraces the principal work done at the station by him, with plans for the future, and will be read with interest, I am sure.

Lieut. G. A. Converse, U. S. N., the senior assistant, Lieut. R. B. Bradford, and Lieut. A. R. Couden, assistants, have borne the brunt of instruction, and in addition to their duties as instructors have, from their professional knowledge of the wants of the service, advanced its interests very much. They are students and hard workers, and the advancement made by their predecessors is sure to be continued.

Ensign A. L. Case, jr., assigned to duty here by the bureau, in addition to the course taken by the officers under instruction, has made a more thorough study of electricity, and has become a valuable and careful observer.

Mr. Burditt, the gunner in charge of the machine-shop, continues his valuable services, and his mechanical ability is such that even when working full force a foreman is unnecessary.

Respectfully, your obedient servant,

K. R. BREESE,  
*Captain United States Navy,  
Inspector of Ordnance, in charge of Station.*

TORPEDO STATION,  
*Newport, R. I., November 23, 1876.*

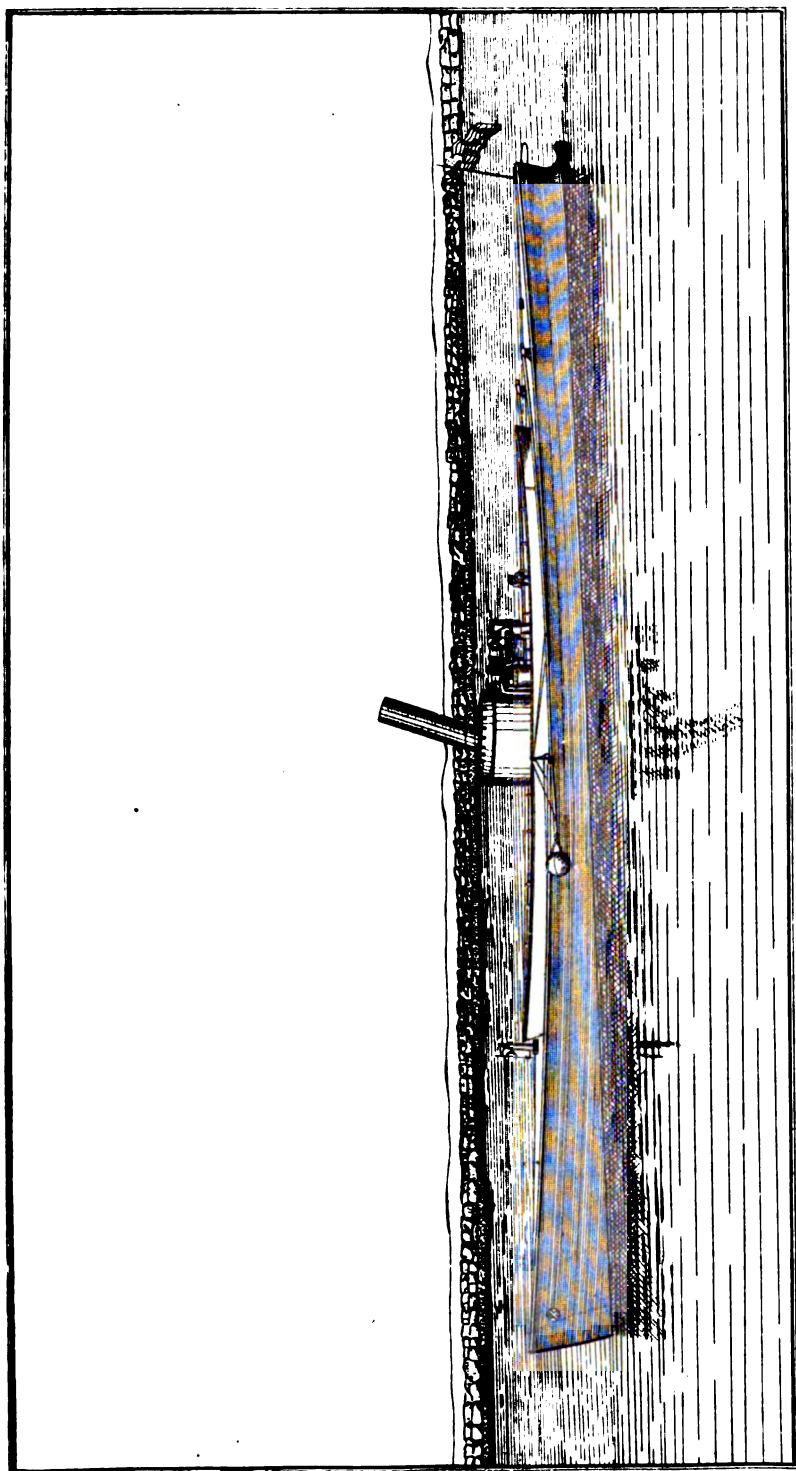
SIR: I have to forward herewith the report of Lieut. G. A. Converse, United States Navy, on the fast torpedo-launch Lightning, and beg leave to add what he has omitted, that the method of carrying the spars and the torpedo is of his device, and that the many improvements of the boiler and its appurtenances were made at his suggestion and under his direct superintendence.

Respectfully, your obedient servant,

K. R. BREESE,  
*Captain United States Navy,  
Inspector of Ordnance, in charge of Station.*  
Capt. WILLIAM N. JEFFERS,  
*United States Navy,  
Chief of Bureau of Ordnance, Washington, D. C.*

UNITED STATES TORPEDO STATION,  
*Newport, R. I., October 25, 1875.*

SIR: In accordance with your orders, I have been to witness the performance of Herreshoff's engine and safety coil-boiler, and have become very much impressed with them for naval purposes in boats. For cheapness, lightness, and doing away with fresh water, they seem to me unsurpassed, and I know of no other boiler upon which steam can be raised so rapidly, and, so far as I can understand, with so much safety. After a trial-trip in a boat propelled by this engine and the safety coil-boiler, which was most satisfactory, we stopped at the wharf, leaving the boat with one hundred pounds of steam, with no one to watch it or care for it. On returning, after an hour or more absence, there was no steam on, and a fair fire. The boat was shoved from the wharf, and a few strokes of a hand-pump in less than five minutes gave as much steam as was desired—80 pounds—steam enough being formed with al-





most the first stroke of the pump to start the engine. I was so much impressed with what I saw that I asked Mr. Herreshoff to submit in general terms a proposal of what he would do for a torpedo-boat, capable of greatest speed, to carry a torpedo either on bow or abeam, with a double engine, and separate engine to drive an electric machine two thousand revolutions per minute, as this would comprise a picket and torpedo boat. I have the honor to submit his estimates.

The reputation of Mr. Herreshoff is of the very highest, and his success as a yacht and boat builder well established. \* \* \*

Very respectfully,

K. R. BREESE,

*Captain and Inspector of Ordnance, in charge of Station.*

Capt. WILLIAM N. JEFFERS,

*United States Navy, Chief of the Bureau of Ordnance.*

BRISTOL, R. I., October 22, 1875.

DEAR SIR: We will build you a steam-launch, suitable for a torpedo-boat, as follows: Boat to be 55 feet long, 6 feet 3 inches wide, fitted with our safety-coil boiler, and a pair of engines with the combined capacity of 60 horse-power, which will run the boat 19 miles an hour.

The boat will also be furnished with a steam-pump for boiler, and one 12 horse-power engine suitable to run an electric-light machine.

The boat and machinery to be constructed in the strongest manner and with the least weight, yet boat strong enough to sustain the machinery, when it is hoisted out of water, without any strain on it.

Said boat to be delivered at Newport on or before April 1, 1876, for the sum of \$5,000.

Should the Department decide to get us to build as proposed, we will send specification in detail.

Yours, truly,

JOHN B. HERRESHOFF,

*Agent Herreshoff Manufacturing Company. S. H.*

Captain BREESE.

[Indorsement.]

In conversation, Mr. H. states will run for half an hour at the rate of 19 miles an hour, 16 to 16½ steadily.

K. R. B.

*Specifications for building torpedo-boat for Bureau of Ordnance.*

Dimensions of hull: Length over all, 55 feet; beam, 6 feet 3 inches; depth, 3 feet 3 inches.

Keel, stem and stern posts to be of white oak; keel to be sided 4½ inches.

Frame to be of white oak, steamed and bent; molded 2½ inches, and placed 11 inches apart from centers.

Outside planking to be of yellow pine ⅞ inch thick.

Ceiling and floor to be of yellow pine; ceiling ¾ inch, floor ⅞ inch.

Shear-streak to be of oak, ¾ inch thick.

Clamps and deck-frame to be of yellow pine; clamps ¾ inch, deck-frame 2½ inch, molded.

Deck to be of white pine,  $\frac{9}{16}$  inch thick.

Space in center of boat to be left open 28 feet, with high wash-board around same.

Machinery to be as follows:

To have two 5 by 10 inch engines, and one Herreshoff safety-coil boiler of sufficient size to run said engine 400 turns per minute with 140 pounds steam, following  $\frac{3}{4}$  strokes.

Boat also to have all gauges, valves, and pipes necessary for said engines and boiler, and one steam-pump and one feed-pump connected to engines.

Propeller-shaft to be of steel, after end of which is to be covered with bronze.

Propeller-wheel to be of bronze.

Rudder to be of yellow metal, with steel rudder-stock.

Fastenings: Hull of boat to be fastened with galvanized iron, and all materials used in hull and machinery to be of first quality.

Boat to be built in our best manner, and well painted with two coats of paint.

Boat also to be furnished with one engine, attached to boiler, to run an electric machine, and to be capable of developing 12 horse-power.

The coil in boiler to be made of best-quality 2-inch exterior lap-welded steam-pipe  $\frac{1}{16}$  inch thick.

Jacket to be doubled, of sheet-iron and brass.

Boiler to have a drum, so that salt water can be used as well as fresh without injury to boiler.

Engines to be constructed of best materials. All studs, bolts, and shafts to be made of Ulster iron; rods, pins, and keys to be made of steel. To be furnished with the Herreshoff cut-off valves.

The boat to be properly braced.

Screw-bolts to be used in place of rivets.

We agree that the boat shall run 19 miles an hour, and that she can carry two torpedo-poles of 38 feet length each, one on each side; said poles to be worked from the boat with 100-pound steel-cased torpedoes on each.

The price to be \$5,000 dollars, payable as follows: \$1,250 when the frame of hull is up; \$1,250 when hull is ready to be painted; \$1,250 when the boiler and engines are completed; \$1,250 when the boat, with its machinery, is completed and tried.

The boat and machinery subject to inspection, and to be satisfactory before the payments are made.

JOHN B. HERRESHOFF,

*Agent Herreshoff Manufacturing Company.*

Witness to signature: In presence of—

J. BUMSTEAD.

BUREAU OF ORDNANCE, NAVY DEPARTMENT,  
Washington City, November, 4, 1875.

SIR: Your letter of the 2d instant, inclosing specifications and contract for building one torpedo-boat, has been received.

The bureau approves and accepts the same, but with the following modifications, viz: The speed to be 19 miles per hour for *one hour, using salt water*, and desire you to commence the work without delay.

I inclose you a tracing from a sketch of one of Thornycroft's fast steam torpedo-launches, which has made 21 miles per hour, developing 120 horse-power.

I am, sir, your obedient servant,

WILLIAM N. JEFFERS,  
*Chief of Bureau.*

Mr. JOHN B. HERRESHOFF,  
*Agent Herreshoff Manufacturing Company, Bristol, R. I.*

BUREAU OF ORDNANCE, NAVY DEPARTMENT,  
*Washington City, November 5, 1875.*

SIR: The bureau forwards copy of the contract of the bureau with Mr. Herreshoff for the construction of the torpedo-boat.

When Mr. Herreshoff reports that the boat is ready for the several inspections, you will detail an officer to make them, whose certificate will be the voucher for the several payments.

The bureau sends you, for the files of the torpedo-station, a copy of a general sketch of Thornycroft's last fast torpedo-launch, with his arrangement for using the poles abeam or on either side, which, from comparison with a photograph, the bureau believes to be substantially correct.

Thornycroft told Captain Ramsay that one of the main things in the construction of these fast torpedo-boats was to see that they were thoroughly braced, as vibration killed the speed.

I am, sir, your obedient servant,

WILLIAM N. JEFFERS,  
*Chief of Bureau.*

Capt. K. R. BREESE,  
*Inspector of Ordnance, Torpedo Station, Newport, R. I.*

*Official trial of torpedo-boat.*

NARRAGANSETT BAY,  
*Wednesday, 24th May, 1876.*

*Course.*—From Usher's buoy, Bristol Harbor, to Bishop's Rock buoy, Coaster's Harbor, and return.

*Distance.*—From Usher's buoy to Bishop's Rock buoy,  $10\frac{1}{2}$  statute miles; total distance,  $20\frac{1}{2}$  statute miles.

*Coal.*—English cannel.

Number of persons on board, 5.

Started fires at 9<sup>h</sup> 41<sup>m</sup>.

Steam, 80 pounds, at 9<sup>h</sup> 46<sup>m</sup> 45<sup>s</sup>.

Time required to raise steam, 5<sup>m</sup> 45<sup>s</sup>.

At 9<sup>h</sup> 46<sup>m</sup> 45<sup>s</sup> started up Bristol Harbor.

At 9<sup>h</sup> 48<sup>m</sup> stopped to set up packing of feed-pump.

At 10<sup>h</sup> 4<sup>m</sup> headed down for Usher's buoy.

*Record of trip.*

Object.	Down trip.			Elapsed time.	Return trip.			Elapsed time.
	Time passed object.				Time passed object.			
Usher's buoy.....	<i>h.</i>	<i>m.</i>	<i>s.</i>	<i>m.</i>	<i>s.</i>	<i>h.</i>	<i>m.</i>	<i>s.</i>
	10	09	00			11	56	28
Southwest Point buoy .....		14	04	5	04		51	04
Sandy Point light .....		18	55	4	51		44	54
Dyer's Island, southwest buoy .....		24	42	5	47		37	30
Bishop's Rock buoy .....		35	45	11	03		23	30
Time over course.....		26	45	26	45		32	58

Distance..... 10.12 statute miles. Time..... 26<sup>m</sup> 45<sup>s</sup> down trip.

Distance..... 10.12 statute miles. Time..... 32<sup>m</sup> 58<sup>s</sup> return trip.

Total distance. 20.24 statute miles. Total time. 59<sup>m</sup> 43<sup>s</sup>

## DOWN TRIP.

*Sea.*—Smooth.

*Tide.*—Ebb.

*Wind.*—Light ahead.

*Steam.*—Steady at 140 pounds.

*Engines.*—Working as well as could be desired. No parts of the machinery showed the slightest signs of heating.

*Boiler.*—Working well.

NOTE.—Finding that the quantity of coal on board would not be sufficient to last for the return trip, it was deemed best to continue course to torpedo-station and get more. It was the first time any of the people on board had used English coal, and the consumption was much greater than on previous occasions when American coal was used.

## RETURN TRIP.

*Sea.*—Smooth.

*Tide.*—Strong ebb.

*Wind.*—Moderate breeze astern.

*Steam.*—Average about 100 pounds.

*Engines.*—Worked as well as could be desired. No parts of machinery showed the slightest signs of heating.

*Boiler.*—Made steam freely and worked well.

NOTE.—When a short distance above Bishop's Rock buoy the pipe connecting with after steam-gauge blew out at joint with steam-drum. Plugged hole with pine stick without stopping. Plug blew out three times. Carried low steam while repairing. Average during return trip, not over 100 pounds.

Very respectfully, your obedient servant,

G. A. CONVERSE,

*Lieutenant, and Assistant Inspector of Ordnance.*

To Capt. K. R. BREESE, U. S. N.,

*Inspector of Ordnance, in charge of Torpedo Station.*



*Record of times noted during trial-trip of steam torpedo-launch, May 24, 1876, by Lieut. A. R. Couden, at Bishop's Rock buoy, and Ensign A. L. Case, at Usher's buoy :*

Passed Usher's buoy, from Bristol, at.....	10 <sup>h</sup> 09 <sup>m</sup> 11 <sup>s</sup>	
Passed Bishop's Rock buoy, from Bristol, at.....	10 <sup>h</sup> 35 <sup>m</sup> 55 <sup>s</sup>	
Elapsed time.....		26 <sup>m</sup> 44 <sup>s</sup>
Passed Bishop's Rock buoy, to Bristol, at.....	11 <sup>h</sup> 23 <sup>m</sup> 48 <sup>s</sup>	
Passed Usher's buoy, to Bristol, at.....	11 <sup>h</sup> 56 <sup>m</sup> 45 <sup>s</sup>	
Elapsed time.....		32 <sup>m</sup> 57 <sup>s</sup>
Total time from Usher's buoy to Bishop's Rock and return..		59 <sup>m</sup> 41 <sup>s</sup>
Passed Usher's buoy, at.....	10 <sup>h</sup> 09 <sup>m</sup> 11 <sup>s</sup> down.	
Passed Usher's buoy, at.....	11 <sup>h</sup> 56 <sup>m</sup> 45 <sup>s</sup> up.	
Elapsed time.....		1 <sup>h</sup> 47 <sup>m</sup> 34 <sup>s</sup>
Passed Bishop's Rock at.....	10 <sup>h</sup> 35 <sup>m</sup> 55 <sup>s</sup> down.	
Passed Bishop's Rock at.....	11 <sup>h</sup> 23 <sup>m</sup> 48 <sup>s</sup> up.	
Time off course.....		47 <sup>m</sup> 53 <sup>s</sup>
Time on course.....		59 <sup>m</sup> 41 <sup>s</sup>

Very respectfully, your obedient servants,

A. R. COUDEN,  
Lieutenant, and Assistant Inspector of Ordnance.  
A. L. CASE,  
Ensign, and Assistant Inspector of Ordnance.

To Capt. K. R. BREESE, U. S. N.,  
Inspector of Ordnance, in charge of Torpedo Station.

[Telegram.]

WASHINGTON, D. C., May 25, 1876.

Captain BREESE,  
Newport, R. I.:

Telegram received. Accept Lightning.

JEFFERS,  
Chief of Bureau.

The boat, having been accepted by the bureau, was delivered at this station on the 1st of June, 1876.

Since the boat arrived several changes have been made in it with the view of making the piping of the boiler and connections with the engines more compact, and hence better suited for the special use for which it is designed. Modifications in the furnace, and form of exhaust-pipe, have also been made, and hard coal is now habitually used with most satisfactory results.

The torpedo-fittings have been made and put in place, and a dynamo-electric machine and electric lamp and attachments are also fitted. The boat is thus completed for service either as a torpedo or picket launch.

A number of experiments have been made with it during the past summer. The result of these experiments has been quite satisfactory, fully realizing all anticipations in regard to speed and the general fitness of the boat for the special use for which it was designed.

Arrangements have been made for having an extended trial for the purpose of determining the consumption of coal, capabilities of machinery, &c.; but the protracted unfavorable weather, and the small number of men employed at the station during the past two months, have rendered it necessary to postpone the trial for the present.

#### *Detailed description of boat.*

**Hull.**—Length over all, 58 feet; beam, 6 feet 3 inches; depth of boat, 3 feet 2 inches; draught forward, 14 inches; aft, 22 inches; dimensions of timber, &c., keel, oak, sided,  $4\frac{1}{2}$  inches; boiler or bilge keelsons placed in wake of boiler and machinery; frames, oak, molded  $2\frac{1}{2}$  inches, and placed 11 inches apart from centers; intermediates half-frames in wake of boiler and machinery. Planking, pine,  $\frac{1}{8}$  inch thick; ceiling, pine,  $\frac{3}{8}$  inch thick; floor, pine,  $\frac{9}{16}$  inch thick; shear-streak, oak,  $\frac{5}{8}$  inch thick.

**Deck.**—Extends 14 feet from bow and 14 feet from stern; wash-board, 8 inches high around open space.

Weight of hull, 2,800 pounds.

**Boiler.**—Herreshoff's patent safety coil-boiler, fitted with a feed-water heater and a separator for using salt water. Height, 5 feet 2 inches; diameter, 4 feet 2 inches; heating-surface, 130 square feet; grate-surface, 9 square feet; weight, 1,500 pounds.

**Engines.**—Double, direct acting; cylinders, 5 inches diameter, 10 inches stroke; fitted with Herreshoff's patent cut-off valves; shaft, rods, studs, and bolts of Ulster iron; pins and keys of steel; weight, 1,040 pounds.

**Propeller shaft.**—Steel incased in brass; length, 27 feet; diameter, steel,  $1\frac{1}{8}$  inches; brass,  $\frac{1}{2}$  inch thick; total diameter,  $1\frac{7}{8}$  inches; weight of shaft and bearings, 340 pounds.

**Propeller.**—Bronze, two blades, placed abaft rudder; diameter, 38 inches; mean pitch, 60 inches; length, 6 inches; weight, 52 pounds.

**Auxiliary pump.**—Knowles, size No. 0; weight, (estimated,) 200 pounds.

**Engine for electric light.**—Single, direct acting; cylinders,  $3\frac{1}{2}$  inches diameter, 7 inches stroke; fitted with Herreshoff's patent cut-off valves; fly-wheel, 20 inches in diameter; drives electric machine 2,000 revolutions per minute; weight, 250 pounds.

**Total weight of boat,** with permanent fittings, 6,900 pounds.

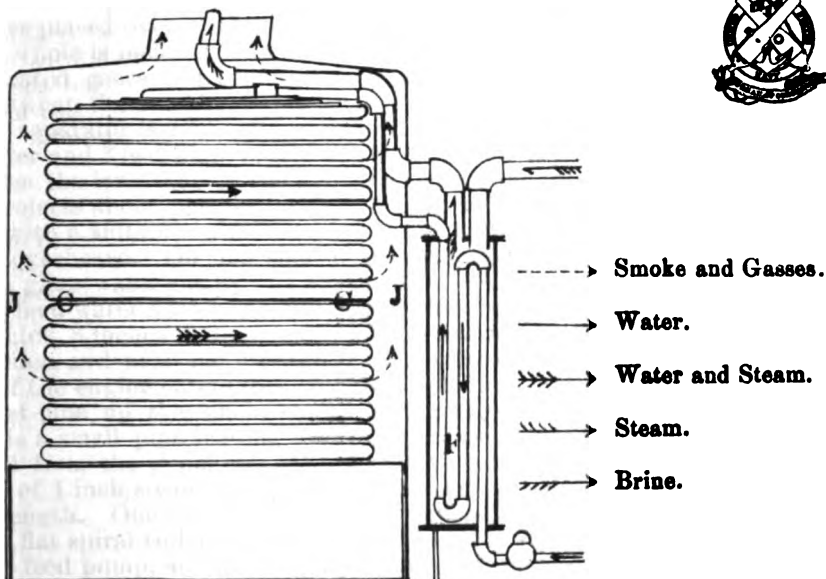
#### *General description of boiler.*

As the boiler is a novel feature of the boat, the following general description and method of operating it are given:

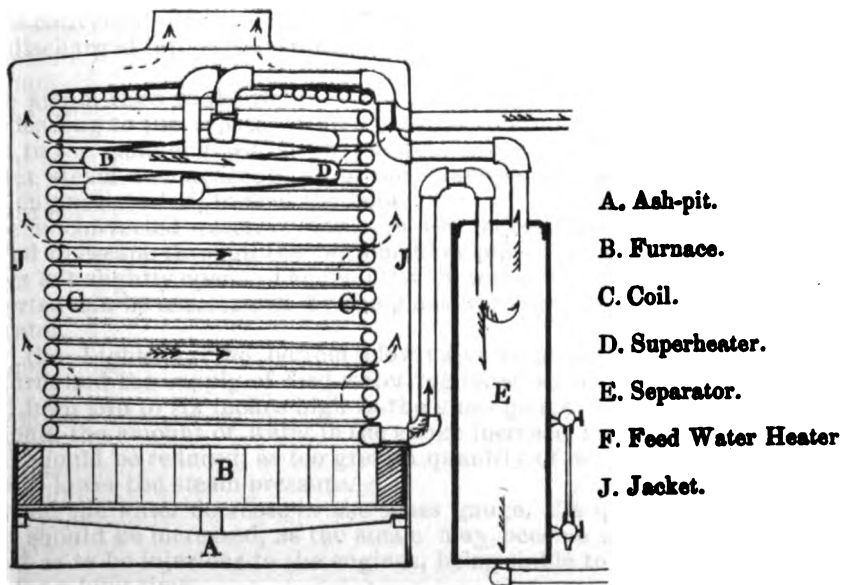
**Description.**—The boiler consists of a flat, spiral coil of 1-inch steam-pipe, the exterior diameter of the coil being 42 inches. The turns of this coil are wound as close together as possible, and the outer end connects to the upper end of a vertical spiral coil of 2-inch steam-pipe, the diameter of this coil being 42 inches and height 3 feet 4 inches. The turns of the vertical coil are separated  $\frac{1}{8}$  of an inch, and the lower end is connected to the upper end of the separator.

The bottom of the vertical coil is placed about 10 inches above the grate-bars, resting on fire-brick, which forms the outside of the furnace, and being firmly secured by upright braces. The interior of the coil

## Boiler of Steam Torpedo Launch "Lightning."



Jacket of Boiler removed—Section through Feed Water Heater.



Section through Boiler and Separator, showing Superheater.



thus forms a large combustion-chamber, the smoke and heated gases escaping through the spaces between the turns of the vertical coil, egress through the top being prevented by the closeness of the coil and a shade or cover placed over it for this purpose.

The whole is inclosed by a jacket, which serves to confine the smoke and heated gases and conveys them to the smoke-pipe, a space being left between the outside of the coil and inside of the jacket.

The separator is a cylinder made of  $\frac{1}{4}$ -inch boiler-iron, 12 inches in diameter and 3 feet high, placed on end abaft the boiler. The pipe leading from the lower end of the boiler-coil enters the top of the separator, and projects about 8 inches inside. A pipe called the bottom blow-pipe, fitted with a suitable valve, connects to the bottom of the separator and leads overboard. On one side of the separator, near the bottom, is fixed a glass water-gauge.

The feed-water heater is a cylindrical chamber, made of iron  $\frac{1}{8}$  of an inch thick, 8 inches in diameter and three feet high, placed on end abaft the boiler, and near the separator. The exhaust-steam from the cylinders of the engine enters this chamber, and then escapes through the exhaust-pipe up the smoke-stack. From the bottom of the chamber there is a small pipe leading overboard, through which the water condensed from the steam escapes. Inside the chamber are several short pieces of 1-inch steam-pipe, joined at the ends so as to form one continuous length. One end of this group of pipes connects to the inner end of the flat spiral coil of the boiler; and the other end is connected to the engine-feed pump, and also to the auxiliary steam and hand pump.

*Method of operation.*—After the fires have been started and the pipes have become warm, water is forced into the coil of the boiler by means of the hand-pump. The water enters the coil at the top, which, being farthest from the fire, is coolest.

As it descends in the spiral coil it gradually gets hotter, and a part of it is converted into steam. The unconverted water and steam are both discharged into the separator, the water or brine falling to the bottom.

The steam rises to the top of the separator and escapes through the pipes leading to the separator and main steam-pipe, from which it is taken to the main engines, steam-pump, auxiliary engine, and ejectors.

After steam commences to form, the steam-pump can be used, or the main engines started, to feed the boiler.

The unconverted water, or brine, in the bottom of the separator, is allowed to escape through the bottom blow-pipe, the valve of which is always left slightly open. The quantity of water which comes over unconverted can be ascertained by the glass water-gauge attached to the separator.

In the Lightning the bottom blow-valve is usually left open  $\frac{1}{2}$  of one turn, and the supply of feed-water regulated so that the brine shall stand from two to six inches high in the glass gauge.

Should the amount of water in the gauge increase, the supply of feed-water should be reduced, as too great a quantity of water will cool the coil and lower the steam-pressure.

Should the water decrease in the glass gauge, the quantity of feed-water should be increased, as the steam may become so highly superheated as to be injurious to the engines, being liable to cut them when used for a long time.

For short spurts with the boat, however, the water has frequently been allowed to disappear from the gauge and the bottom blow-valve has been entirely closed, the cylinders of the engine being constantly

lubricated. By this device the steam-pressure has been raised from 100 pounds to 160 pounds in less than two minutes.

Under ordinary circumstances the bottom blow-valve is first opened  $\frac{1}{2}$  of one turn, and the supply of feed-water regulated to keep the water about two inches high in the glass gauge. All salt and mineral substances are then carried over in the unconverted water as a strong brine, and are ejected through the bottom blow-pipe. Crystals of salt appear about the glass gauge, while not the slightest trace of it can be detected about the engine.

On first raising steam it is desirable to let the coil get quite hot before injecting water. The coil expands under the influence of the heat, and any scale or deposit that may be on it becomes detached. If the bottom blow-valve be opened wide, and the water then injected, the scale and dirt are forced overboard, thereby preventing small particles from going through the engines and injuring them.

By treating the boiler of the Lightning in this manner no scale or deposit was found in the coil of the boiler after having been run for four months, and using salt water during all the time it was under steam.

#### *Torpedo fittings.*

The boat is supplied with two torpedo-spars, designed to be used on the broadsides. The heel-fittings are placed well aft on the quarters of the boat, and the spars and torpedoes are carried on the rail. When eased off, the spars swing aft, and the outer ends descend to the proper depth, 10 feet; the torpedoes then being 20 feet horizontally from the boat's side. The spars are prevented from going too far aft by a forward guy.

The spars are eased off from the rail by means of slip-ropes, and can be rigged out when going ahead at moderate speed.

When out, the effect of a single spar and torpedo on the steering of the boat is comparatively small.

The torpedoes are made to contain 30 pounds dynamite or other violent explosive, and are to be exploded on contact or at will.

When the explosion takes place the forward guy is carried away and the spar trails aft.

*Heel-fittings.*—Steel; weight, 130 pounds each.

*Torpedo-spars.*—Steel; length, 22 feet; exterior diameter, 2 inches; thickness of steel,  $\frac{1}{8}$  inch; displacement, 16 pounds; weight, 34 pounds. (Spars are trussed for 12 feet from outer end.)

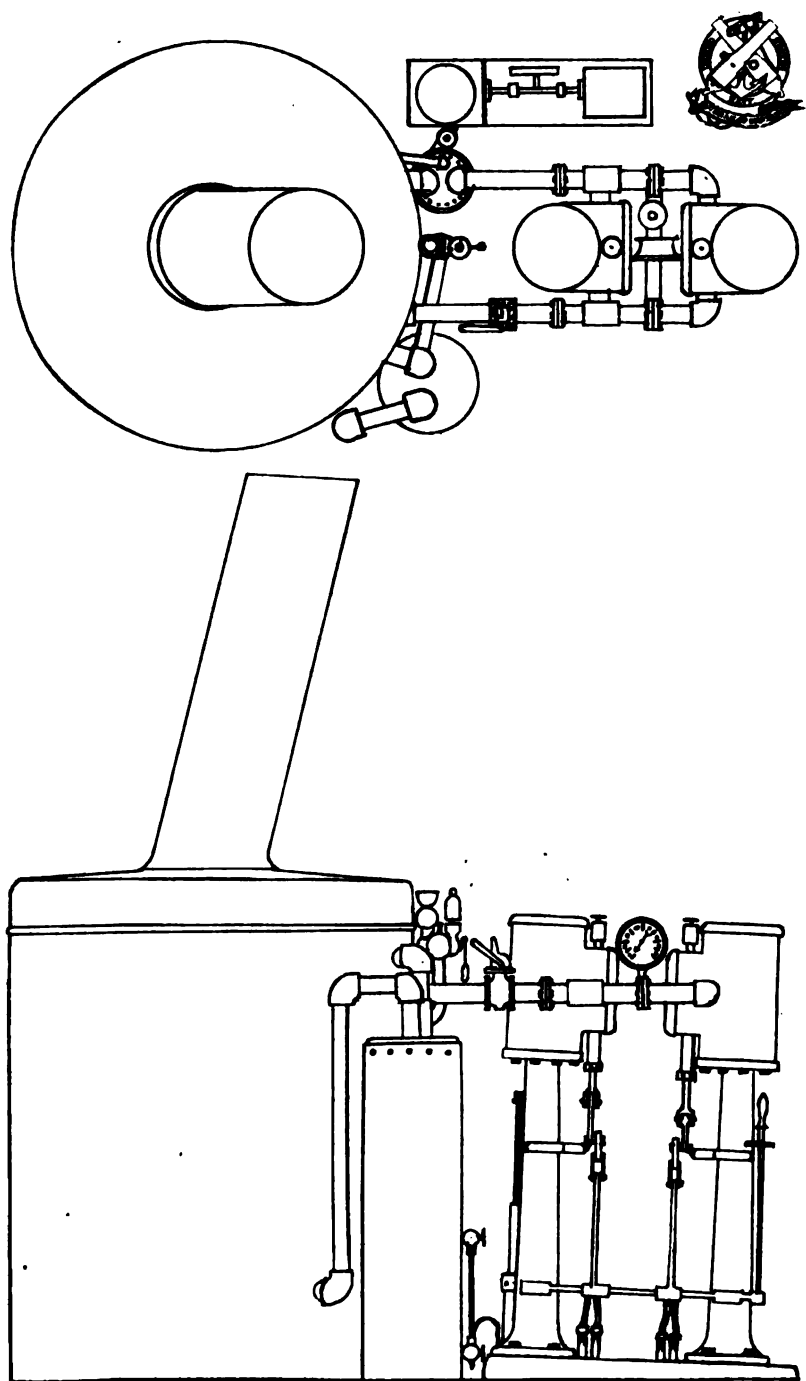
*Torpedoes.*—Steel; spherical in shape; diameter, 12 inches; weight empty, 11 $\frac{1}{2}$  pounds; capacity, 30 pounds dynamite; weight, filled, 42 pounds; displacement, 38 pounds.

*Forward guys.*—Wire-rope,  $\frac{3}{8}$  inch diameter.

#### *Electric-light machine and lamp.*

*Machine.*—A small-sized Gramme electric machine has been put on board temporarily. When driven at 2,000 revolutions per minute (the usual speed) it produces a light equivalent to about 500 candles. It is proposed to have a more powerful machine, of Farmer's patent, built for the boat.

*Lamp.*—The lamp used is one of Farmer's non-automatic carbon lamps, inclosed in a suitable lantern. It is situated on the forward deck, just in front of the wheel, and can be worked by the person who steers the boat.



**Boiler and Engine of Steam Torpedo Launch "Lightning."**





TORPEDO STATION,  
Newport, R. I., September 16, 1876.

*Description of steam dingy.*

Steam dingy, built by the Herreshoff Manufacturing Company of Bristol, for the Bureau of Ordnance, in conformity with the specifications submitted to the bureau on the 19th of January, 1876.

*Trial of the boat.*

By the terms of the specifications the dingy was to have been submitted for trial on the 1st June. Owing to delay in procuring the shaft the boat was not presented for trial until some time after.

*Dimensions.*

	By specifications.	By measurement.
Length over all.....	22 feet.	23 feet.
Greatest beam.....	4.75 feet.	5.4 feet.
Depth .....	2.25 feet.	2.8 feet amid., 3.5 feet forward.

*Floating capacity.*

By the specifications the boat was to have a floating capacity of 1,000 pounds when filled with water. When filled to the rail the boat sustained eight persons whose aggregate weight amounted to 1,130 pounds.

*Speed.*

Course from buoy south of Goat Island to Goat Island light and return. Distance between buoy and light  $\frac{3}{8}$  of a statute mile. Tide, strong ebb; wind, light from northward.

Course.	Distance.	Tide.	Wind.	Steam.	Time.	Average speed.
Buoy to light.....	27.98 mile ..	Against ..	Against ..	80 to 140, average 120 ..	m. s. 7 40	7.55 miles.
Light to buoy.....	27.26 mile ...	With.....	With.....	130 to 180, average 140 ..	6 10	9.38 miles.

Mean pressure, 130 lbs.; mean speed, 8.46 miles.

*Propeller.*

Propeller of bronze, 2 blades; diameter, 20".5. Mean pitch, 30".

*Fuel.*

Lackawanna coal, chestnut size, gives very satisfactory results. Mr. Herreshoff states that on the trip from Bristol to Newport, 12 $\frac{5}{8}$  miles, the consumption was about 48 pounds.

Very respectfully, your obedient servant,

G. A. CONVERSE,  
Lieutenant, U. S. N., and Assistant Inspector of Ordnance.

UNITED STATES TORPEDO-STATION,  
*Newport, R. I., November 25, 1876.*

CAPTAIN: I respectfully submit the following report in regard to the torpedo-igniters and fuses which have been manufactured at this station for issue to ships, and also of the progress of the experiments which are being made with a view to improve them.

The present form of copper-case igniter and fuse was approved by the bureau and ordered to be a part of the torpedo-outfit of vessels, in August, 1874. Since then about 4,000 igniters have been made, and upward of 1,000 have been issued to the service. Nearly 2,000 have been used at the station for general torpedo-practice and experimental work.

Of those used at this station, taken from the general store kept on hand, not a single instance has occurred in which a torpedo has failed to explode from a defective fuse; nor have any defective fuses been found among those which have been placed in store for issue.

No failures of the present form of igniters and fuses have been reported from any of the vessels in service; and those returned from ships going out of commission have always been found in perfect order.

As the successful explosion of a torpedo depends on the reliability of the fuse, it would seem advisable that in all cases when an imperfect fuse is found a special report of all the circumstances should be forwarded to this station, in order that defects might be remedied and perfection attained.

A percentage of the fuses which have been in store longest—since June, 1875—was recently examined to ascertain if any deterioration had taken place.

The electrical properties of these fuses were found to be exactly the same as when made.

The gun-cotton priming was in excellent order.

The powder-filling was in good order.

The interior of the copper cases and surface of the wires were found to be coated with a black substance—sulphide of copper. This fine powder was removed, and no perceptible injury to case or wires was discovered. Judging from appearances, the life-time of the igniter would far exceed all requirements.

In view of the defects found in the copper-cased small-arm ammunition formerly issued to the service, the above condition of the igniter-cases was not unexpected. It is thought, however, that the deterioration in the small-arm ammunition was much more rapid than in the igniters, owing to the presence of fulminate in the former.

Coating the interior of the copper case and surface of copper wires with shellac, or similar substance, would probably prevent the action of the sulphur of the powder on the copper.

A quantity of brass cases has recently been received, and it is proposed to substitute them for the copper, to ascertain if they possess any advantages.

For firing the present service torpedo-fuse, a current of electricity having a strength of six-tenths of a weber is required. As galvanic batteries are now frequently supplied to ships for firing torpedoes, it is desirable that the strength of current necessary to fire the fuse should be reduced to a minimum, in order that a small number of cells of battery may be sufficient to do the work.

Experiments have been made with wires of various alloys, in hopes of finding some one which could replace the present platinum-silver to advantage.

Various alloys of gold-iron and palladium-silver have been used, being made into a fine wire, No. 40, 0.0023 of an inch in diameter.

A wire suitable for the bridge of a torpedo-fuse should possess the following requisites, viz :

It should not oxydize when exposed to moisture or sea-air for a long time.

Its specific resistance should be high.

The resistance should be uniform, and should not increase greatly with increase of temperature.

It should have great tensile strength.

Of the alloys tried, gold-iron gives the most satisfactory results. With a bridge of the same dimensions as the present platinum-silver-wire bridge of the service igniter, the strength of current required to fire the priming material is only 0.35 of a weber, or a little more than half that required for the platinum-silver. The tensile strength, however, is not as great, and the bridge is liable to become broken in the process of manufacture, and would not stand the rough usage to which the service igniters are frequently exposed. The proportions of the components of the alloy are being changed, and as soon as the new wire is received the experiments will be resumed.

I am, sir, very respectfully, your obedient servant,

G. A. CONVERSE,

*Lieutenant, and Assistant Inspector of Ordnance.*

Capt. K. R. BREESE,

*Inspector of Ordnance, in charge of Torpedo-Station.*

Approved, and respectfully forwarded to the Bureau of Ordnance.

K. R. BREESE,

*Captain, U. S. N., Inspector of Ordnance, in charge of Station.*

UNITED STATES TORPEDO-STATION,  
*Newport, R. I., December 1, 1876.*

SIR : In obedience to your order, I have the honor to submit the following paper upon the subject of torpedoes :

The present condition of the torpedo for naval purposes may be compared to that of the first reliable guns, very formidable and much dreaded in warfare, yet capable of great improvement.

All of our naval vessels have been supplied with torpedoes and their necessary attachments from this station since 1870, and during that time many improvements have been made. In fact, no one article of the original pattern is now supplied, and many articles have been changed several times, each time an improvement being added. Most of these changes have been brought about by experimental work at this station, under circumstances as near as possible to those of actual service. A few can be traced to experiments and the use of torpedoes by cruising-ships, but, as a rule, experimental knowledge can only be gained by those who are experts, and who have facilities for more extensive practice than are possessed by any cruising-ship with her comparatively small outfit of material. In order to progress, then, in the science of torpedo warfare, or even keep pace with the times, it is necessary to have facilities at this station for conducting a large number of experiments.

Torpedoes for the naval service may be divided into three general classes, viz, spar-torpedoes, towing-torpedoes, and movable or fish

torpedoes. These three kinds will probably be used by the Navy in time of war, and the first two classes are now supplied to all cruising-ships.

Although anchored torpedoes for the defense of harbors are under the control of the Army, engineers, a knowledge of them is by no means neglected here, as naval officers may at any time be called upon to operate against them, as well as to use them as auxiliary defensive weapons.

A defense of ships against torpedo attacks of all kinds is also considered, but this part of torpedo warfare is at present very imperfectly developed, principally from the fact that the offensive qualities of any weapon must first be learned before means of defense can be provided, and also from the fact that the most effective means of defense are invented only during actual warfare. No nation can afford to run the risk of losing a fine vessel of war for the purpose of testing any means of defense, and much less a nation pursuing a policy like our own. This is an important subject, however, and at present we are obliged to look to foreign nations for the greater part of our experimental knowledge upon it, the recent experiments of the English upon the hulk *Oberon*, where the two types, spar and towing torpedoes, were represented, being the most important. These experiments demonstrated that both types were exceedingly destructive.

In order to make the subject of experimental work here still more clear, a brief outline of some of the most important experiments since July, 1875, that have taken place is given.

*Spar-torpedoes.*—It had occurred once to a cruising-vessel that while a service 100-pounder torpedo was being towed at full speed, the spindle of the torpedo, which serves to connect the latter to the spar, had broken. It was not fairly decided whether this accident was owing to the pressure of water on the torpedo-case, or whether the latter had struck some floating debris. After a series of experiments here with the tug *Nina*, and the fast steamer *Despatch*, it was decided that both the spindle and the socket, the latter lashed to the spar and holding the former, were too weak. Since then stronger ones have been furnished to cruising-ships.

It was thought that the service spar was more frequently broken by the explosion of torpedoes than was necessary, and that the question of saving it was only one of comparative strength between the spar itself, the fastenings of the torpedo to it, and the force of the explosion. The number of lashings around the socket and spar were reduced, and the proper number to give only sufficient strength for towing purposes determined. Instructions have since been issued detailing the proper number and kind to be used.

Experiments have been tried with a view to prevent the rising of the spar and torpedo, at high rates of speed, by raising the point of contact of the heel of the spar with the ship's side. It was found that a marked effect was produced by raising it but slightly.

The effect of securing the heel of the spar to the ship's side with some elastic material was tried. It seemed to reduce the shock upon the spar at the explosion very materially; but these experiments are incomplete, and it is considered important to continue them with a properly constructed buffer.

A series of experiments have been conducted to determine if a torpedo-spar could not be better supported, thereby checking vibrations, by attaching the forward guy and topping-lift to it by means of spars

of different construction than had been used. A new method was recommended, which has since been adopted in the service.

Taking advantage of the presence of the United States steamer *Despatch*, at Newport, it was determined to test the strength of the service spar, that vessel being capable of running at high rates of speed. A service spar was selected indiscriminately out of several, and towed with a service 100-pounder torpedo. The torpedo was fitted with the new and strong spindle and socket, and they showed no signs of weakness. The spar broke at a speed of  $10\frac{1}{2}$  knots. It was observed that the speed of the *Despatch*, when she was running her best, was decreased by the resistance of the spar and torpedo, while towing abeam, from 20 to 25 per cent. This decrease would not have been so great had the vessel been large and had she drawn more water; but it points out the great necessity of decreasing the volume, and particularly the vertical cross-section of the spar and torpedo.

A series of experiments, extending over more than a year's time, have been conducted with a view to perfect an improved torpedo-spar. The principal defects of the present service spar are, want of strength, too great resistance while towing at high rates of speed, and a tendency to come to the surface while towing. Three spars have been constructed, all on the same principle, and made of steel and wood. The first two were broken while testing, but the third has been tried very severely; as for instance, towing in a sea-way when the towing-vessel had both a rolling and a pitching motion. No less than eleven service 100-pounder torpedoes have been exploded from it, some of them in very shoal water, and the spar is apparently as good as ever. Owing to the shape of the spar, the greater the speed the more the tendency to go down, though the topping-lift prevents it from taking anything below the proper immersion. Its resistance is less, as shown by a decreased effect on the helm, and as it needs must be from its decreased cross-section. Its remarkable strength has already been alluded to, the service spars often breaking at the first explosion, and rarely ever withstanding more than two or three. It is thought that this spar can be still further improved, and it is deemed very important that it should be, and then supplied to cruising-ships. Recently two accidents have occurred to prevent the explosion of the torpedo while experimenting with a vessel under way, the spar leading-wire being entirely chafed off. These accidents point to the necessity of protecting this wire, and a tube or pipe for this purpose could easily be introduced into the above spar.

Two patterns of wire-rope compressors, for securing the forward gny of torpedo-spars, so arranged that the forward guy may be suddenly let go, have been tried. One pattern was found to be very convenient for getting the spar out of the way after an explosion, so as not to impede the progress or maneuvering of a vessel. It is very important to so perfect the gear of the torpedo-spar that it may be handled with ease and rapidity and be as much under control as a gun.

Some practical experiments have been tried with voltaic batteries for firing purposes on board ship. An ordinary Leclanchi battery has been kept on board the *Nina* for one year, and during the whole of that time has proved very efficient for firing purposes, having been used much more than it would be in active service, as well as very frequently tested. During one year's use it has not lost more than 25 per cent. of its power. A similar battery was placed on board of the torpedo-boat *Intrepid* nearly a year ago, which has also done good service. Voltaic batteries have many advantages for firing purposes; and if some defects can be

eliminated, which bid fair to be, no doubt they will take the place of magneto-electric machines to a large extent.

Signaling with electric bells has been practiced on board the Nina. No difficulty has been experienced in so arranging these bells that one person stationed at the torpedo-exploding apparatus could with certainty completely control the action of the wheel and engine.

Improved firing-apparatus, applicable either to the use of Farmer's machines or voltaic batteries, was placed on board of the torpedo-boat Intrepid at this station nearly a year ago. Many of the torpedo arrangements of this vessel, placed on board at the same time, were different from those ordinarily furnished, and are fully described in a pamphlet published by the Bureau of Ordnance. All have been satisfactory to her officers, and have never failed in execution up to the present time. The firing-apparatus is placed in the pilot-house, and it is now regarded by all nations as being important to protect the commanding officer and his assistants from the showers of bullets that will be sent from small-arms and Gatling guns when at close quarters. Attention is called to this important subject.

A series of experiments has been conducted with dynamite, with a view to ascertain how much can be safely exploded from a torpedo-launch. Commencing with fifteen pounds, the amount was increased five pounds at a time up to forty. It was apparent that twenty-five pounds could be exploded with the present boat-torpedo apparatus, and, under the same circumstances, with perfect safety to the boat and with as little shock, apparently, as caused by seventy-five pounds of powder. The only noticeable difference was a more violent recoil of the spar. Besides the increased explosive effort of twenty-five pounds of dynamite over seventy-five pounds of powder, there is the great advantage of decreased volume and weight.

Attention is called to the subject of torpedo cases. Those now in use are of cast-iron, large and heavy, and varying greatly in strength. I am convinced that torpedo-cases are more effectual when capable of withstanding a high internal pressure, no matter what the explosive used; and for powder-cases it is almost absolutely essential. It is impossible to have cast-iron vessels with sides as thin as the present torpedo-cases either very strong or of a uniform strength. *The importance of decreasing the weight and volume of any torpedo of a given destructive effect that is to be forced through the water cannot be overestimated.*

For this reason steel cases are recommended in place of the present cast-iron ones. They can be made to bear an internal pressure of 500 pounds per square inch without bursting, and if manufactured in large numbers will be cheaper than the cast-iron ones now furnished. An additional reason for a change is that the present cases were designed for a bow-spar, and are not of a suitable shape to be carried on beam-spars, as is now universally the case with ships. To increase the facility of the carrying vessels for speed and maneuvering by decreasing the volume of the torpedo, no doubt modern powerful explosives will soon take the place of powder.

An improved bow-torpedo apparatus for boats has been successfully experimented with, and attention is called to it as being far superior to that now supplied to steam-launches of the service.

Two different plans of torpedo-apparatus, designed for a fast torpedo-launch, by means of which beam-torpedoes are to be carried, have been perfected. Apparatus according to one plan has been constructed and fitted to the torpedo-launch Lightning, and is now undergoing trial.

Besides what has already been enumerated, there is a large amount

of very valuable knowledge of details acquired in all of the torpedo experiments here, which is given to the service through the officers here under instruction and in printed matter emanating from this station.

#### TOWING-TORPEDOES.

A long series of experiments with different forms of towing-torpedoes was commenced when the station was first established, and continued until 1873. At that time the Harvey towing-torpedo was adopted for our use in the Navy, and has been supplied to cruising-ships ever since.

The Harvey torpedo is towed upon the surface by a wire rope tow-line, and just before reaching the target to be destroyed this tow-line is slacked, and the torpedo, being heavier than water, dives under it. When in this position, the explosion is effected by means of a mechanical firing-bolt being forced down upon a pin, provided the operator is fortunate enough to bring certain levers of the torpedo into contact with the bottom of the target. This torpedo seems to be objectionable for several reasons, among which are the following :

1. It is exploded by mechanical means, and all torpedoes of this type are too dangerous.
2. It requires great skill and practice to bring it into contact with an enemy's vessel; so much so that, with the average officer, if it is accomplished it will only be done by accident.
3. In the night, when it is claimed that torpedoes will be the most useful, the operator cannot see to dive it.
4. It may be exploded at the surface or with a slight immersion, and do no damage.
5. Its present capacity for powder is too small.

Some experiments have been conducted here with a view to fit the Harvey torpedo with electrical firing-apparatus, resulting in a fair amount of success.

During the summer of 1875, a towing-torpedo, designed by an officer formerly on duty here, was constructed and experimented with. It was more simple than the Harvey, was exploded by electricity, either on contact or at will, and possessed an increased capacity for powder. It required, however, to be dove under the target to be destroyed. The results of the experiments with this torpedo, which are still incomplete, indicated that some changes would be required in it, though the electrical apparatus seemed fairly successful.

Another form of towing-torpedoes, designed to be towed under water with a short scope, and to replace the spar-torpedo, has been tried during the past year. The results of these experiments, still incomplete, have not been very successful.

Taking advantage of the presence of the United States steamer Despatch at Newport, about one year ago, the experiment of towing the service Harvey torpedo at high rates of speed was tried. The result was that with a scope of 50 fathoms of tow-line, at a speed of  $10\frac{1}{2}$  knots, the torpedo would not diverge more than  $30^{\circ}$ . The torpedo seemed to be forced out of water by the resistance of the latter so much that it lost its hold and dropped astern as a flat-bottomed boat goes to leeward. Probably more ballast at this speed would be beneficial, but then it would not tow so well at a lower rate of speed. I will here mention that this same difficulty with the Harvey has been found in other countries, and has been the principal reason of its abandonment in some instances.

There is another form of towing-torpedoes, differing from the Harvey by being buoyant, and having a detachable magazine, which, upon con-

tact of the torpedo with its target, automatically drops to a given depth and then explodes. Electric towing-torpedoes of this type are in use in the French and Danish navies, and are towed by a cable with an insulated copper wire heart. Torpedoes of this pattern were largely experimented with here previous to 1873, and one model reached a very fair state of perfection. The essential requisites of a good towing-torpedo are considered to be as follows:

1. If to contain powder, it should have a capacity for 100 pounds.
2. It should be electric.
3. It should have a dropping magazine, dropped upon contact or at will, in order to do away with diving, and to insure an explosion at the proper depth, and at that depth only.
4. It should present as little resistance to towing as possible, and, therefore, should be buoyant and present a small cross-section.
5. It should have considerable keel-surface, in order that it may diverge at all speeds.
6. To do away with buoys and to increase its facility for towing, it should be long.

There is no difficulty in constructing a towing-torpedo that will fulfill the above conditions, provided the means can be obtained.

The necessity for improving the service towing-torpedo is very apparent. The prevailing idea afloat is that it is too dangerous to handle except in times of emergency, and therefore officers will have nothing to do with it.

#### MOVABLE TORPEDOES.

The Ericsson movable torpedo was extensively experimented with at this station during the summer and fall of 1875, the experiments being under the supervision of the inventor's agent, though witnessed by an officer of the station. Although this torpedo had been experimented with during the summer of 1874, from the United States torpedo-vessel *Intrepid*, yet little was known about it here except that the torpedo was not successfully steered. During the experiments at this station, a full knowledge of the mechanism of the torpedo was gained. The torpedo was also so modified as to be perfectly under control, and was sent about under water at will. The experiments with this torpedo required the presence of a steam-vessel, in which was placed the necessary machinery, as well as about fifteen men. During the past summer this torpedo has been on exhibition at the Centennial.

The second movable torpedo, manufactured by Mr. Lay, was purchased by the Government in 1872, and delivered early in 1873. Experiments were commenced with it very soon afterward. The torpedo was run but once, however, by the officers of the station, and was not then under control, when the gas-making apparatus for supplying the motive-power broke down. New and greatly improved gas-making apparatus was then constructed, after plans designed at the station, though it was not completed until the early part of 1874. Experiments with the Lay boat were again commenced in the spring of 1874, but the first time gas was made one of the boat-flasks burst, which led to the condemnation of them all, and new and improved ones had to be made. Makers of vessels comparatively light, that will bear a pressure of 2,000 pounds per square inch, are not common in this country, and the flasks were not ready until the early part of 1875. Much valuable experience, however, was gained by reason of the above accidents. Experiments were once more commenced on the boat in July, 1875. Owing to the fact that nothing was known at this station concerning



the practical working of the boat, and that new material had been placed in it, a long series of experiments, continued throughout the summer and fall, accompanied with a great deal of patient labor under many disadvantages, was necessary in order to reach satisfactory results. Finally the boat was placed in a condition to work perfectly, and its manipulation was equal to that of the inventor himself. In the opinion of the writer, however, the mechanism of this boat or torpedo, in its present condition, is too delicate to be of any practical use. Plans for its modification, which it is believed will render it not only practicable, but superior in speed and in other ways, have been prepared and submitted. I regret that I have not had time to submit some plans that I have in my mind, which would, I think, be a valuable addition to those already submitted. Beyond a question, the Lay torpedo-boat can be highly perfected at this station if the means are allowed. This torpedo-boat has been on exhibition at the Centennial during the past summer.

In October, 1875, the fourth torpedo-boat, manufactured by Mr. Lay, was brought to this station for trial, having been contracted for by the Government. After a series of six trials, this torpedo was removed from this station to Washington, for further trials, and has not since been returned. The result of these six trials, and a description of this more perfected weapon, have been placed upon the records of the station. This second torpedo is a great improvement upon the first received here.

The station movable torpedo, with compressed air as motive power, has not been experimented with recently. Plans for an improved torpedo of this type were prepared by an officer on duty here two years ago, but nothing has been done toward manufacturing a trial weapon.

Suitable apparatus for the trial of submarine rockets and projectiles is now at this station. If successful weapons of this kind can be produced, they will in a great measure take the place of torpedoes in marine warfare. Plans for constructing weapons of this nature are on hand that appear feasible, and that offer a reasonable probability of a successful solution of the subject. This is regarded as an important field for experiment.

It will be observed that most of the experiments described required, and all similar ones in the future will require, the presence of a vessel of some sort at this station. The tug *Nina* has been here for that purpose since the station was established until last September, when, owing to a reduction of the *personnel* of the Navy, her crew were discharged and the vessel was transferred to the New York navy-yard.

The station has greatly increased its usefulness to the Navy during the last three years by entering into new spheres of action and developing facts of a nature hitherto untouched. Were it not well advanced in many points of scientific research it would not receive the high encomiums which it does from learned men, at home and abroad.

To progress as in the past, and in a way that would seem best from *every* point of view, a more liberal allowance of officers, labor, and means than at present exist will be required. England does not hesitate to expend upon one experimental gun more than three times the entire appropriation for this station during the present fiscal year.

I am, sir, very respectfully, your obedient servant,

R. B. BRADFORD,

*Lieutenant and Assistant Inspector Ordnance, U. S. N.*

Capt. K. R. BREESE, U. S. N.,

*Inspector Ordnance, in charge Torpedo Station.*

UNITED STATES TORPEDO STATION,  
*Newport, R. I., November 21, 1876.*

SIR: Within the last year the following electric unions for making temporary splices in electric cables have been tried, viz:

The one hitherto issued from the station, and known as "station pattern," consisting of a brass tube, an inner glass, a rubber gland at each end of the glass tube, and a screw-cap at each end.

One designed by Lieutenant Bradford, consisting of a brass tube lined with gutta-percha, a rubber gland at each end, and a screw-cap at each end.

One designed by Mr. Wilks, consisting of a gutta-percha inner tube, a brass outer tube in two sections, screwing together in the middle, and two rubber glands.

Rubber tubing having a foundation of canvas.

Tarred canvas, served.

Greased canvas, served.

In the accompanying table will be found the results of some of the measurements taken.

For purpose of testing, splices were made in the service cable, using the different unions to cover the splice. The cables containing the splices were then immersed in sea-water at end of ferry-wharf; one end of each was connected to a wire leading to electricity building for measurement.

At the conclusion of the trials it was considered that the rubber tubing was the most satisfactory of those tried. The results obtained from it were uniformly good, which cannot be said of any of the others; it can be procured anywhere, is cheap, and can be applied readily by any one.

The one designed by Mr. Wilks gave very poor results in one trial, and very good results in a second; one difficulty with his union is that, like all other rigid unions, it is apt to break the insulation just at the end of the union, if there is any motion, as in a tide-way. A further objection is that the rubber glands must take fair, which, as you cannot see them, is difficult to insure. If screwed up too tight the insulation will give way; if not screwed up tight enough they will leak.

The tarred or greased canvas might be safely used a few days if necessary.

Very respectfully,

A. R. COUDEN,  
*Lieutenant and Assistant Inspector Ordnance.*

Prof. M. G. FARMER,  
*Electrician.*

Capt. K. R. BREESE:

I herewith submit the above report of Lieutenant Couden, merely adding that a cursory inspection of the tables appears to show great want of uniformity in the results. This is of small account, for the poorest of the unions are good enough, since Farmer's A machine readily fires a torpedo through 200 feet of uninsulated wires in sea-water.

Respectfully submitted.

M. G. FARMER,  
*Electrician.*

[illegible]

TORPEDO STATION,  
Newport, R. I., November 23, 1876.

**SIR :** In addition to the ordinary course of the work of class-instruction during the past year, special attention has been paid to the improvement of the service-igniter, and to the service-union, or cable-joint. Some six or seven miles of subterranean wires were laid down in the summer and autumn of 1875, connecting various points on this island with the electrical laboratory. Most of this wire was insulated with Day's kerite, and a part of it was still further protected by a covering of lead pipe, in accordance with the plan of Professor Hill.

Some twenty-eight gutta-percha-covered wires were also laid from the electrical laboratory to the saluting and testing ground. These wires were laid in trenches to the depth of about twelve or fifteen inches only, one object being to ascertain from experience if this depth would be sufficient for ordinary protection. Thus far it seems to be, though where the wires are buried beneath the cart-path a greater depth would be desirable.

The gutta-percha-covered wires are a portion of a 7-wire cable that had previously been used for a year for the purpose of establishing communication between this station and Rose Island; having been broken by an anchor, it was taken up and portions of it used as above referred to.

The insulation of these wires, while not so high as would be requisite in a long ocean cable, is still more than ample for torpedo purposes.

**Igniters.**—No service-igniter which has been issued during the last two years has yet been reported as defective.

It might be well if orders were issued to report to this station any case of failure, and the reasons therefor, of either service-igniter or service-fuse. No copper-cased igniters issued during the last year and a half have as yet been reported as having failed. All those which have been returned from cruises, and have been examined, have proved to be in good condition.

Satisfactory experiments are in progress to substitute a brass for the copper case. The bridge-wire ordinarily used for the igniter is  $\frac{3}{8}$  of an inch in length and about  $\frac{1}{16}$  of an inch in diameter, and is formed from an alloy of two parts silver with one part platinum.

**Gold-iron wire.**—Some experiments have been made with an alloy consisting of ninety-five parts of gold with five parts of iron, for use as a bridge-wire. The relative resistance of the gold-iron wire is greater than that of the platinum-silver, and a less strength of current is required for ignition with the gold-iron than with the platinum-silver in wires of the same diameter.

**Batteries.**—Various forms of galvanic battery have been and still are undergoing tests, to determine their relative merits on ship and shore. The results of these investigations are shown in the accompanying report, drawn up by Lieut. A. R. Couden, assisted by Ensign A. L. Case, jr.

**Measurement of batteries.**—The question is often asked, what is the best method of determining the electrical dimensions of a battery? In reply, it may be stated that much depends upon the nature and character of the battery to be measured, something also upon the kind of apparatus at hand to effect the measurements with. Supposing you have on hand "Farmer's Gaugain tangent galvanometer," some form of rheostat will also be needed, and then what is known as the shunt method will give the best results in the case of constant batteries. A pair of condensers and a mirror galvanometer will serve best in the case of in-constant batteries.

Suppose that we would measure the internal resistance of a gravity-battery: introduce into its circuit a fine-wire galvanometer and a box of resistance-coil; denote by the letter  $B$  the resistance of the battery and leading wires, and by the letter  $R$  the resistance of the galvanometer and rheostat; if  $E$  denote the electric motive force of the battery, and  $S$  the strength of the current resulting, then from Ohm's law we have

$S = \frac{E}{B + R}$  for the first experiment;  $S$  is also  $= a \tan. \theta$ , where  $\theta$  denotes the deflection of the needle in degrees, and  $a$  is the strength of current when the needle points to  $45^\circ$ . For our second experiment, we will shorten the external resistance  $R$  of the circuit to  $R'$ ; this will make the needle diverge beyond  $45^\circ$ , so we will apply a branch circuit or shunt, of resistance  $S$ , across the poles of the battery, and make this shunt such that the needle returns to the same deflection as in the former experiment; we shall find that the resistance of the battery  $B$  may be expressed by this equation,  $B = \frac{R - R'}{R'} \times S$ ; or, in other words, if  $R$  be twice as great as  $R'$ , then will the battery resistance  $B$  be equal to the resistance  $S$  of the shunt.

*Inconstant batteries.*—In the case of batteries of this class, the best method is to use two condensers of capacities,  $C$  and  $C'$ ; also a mirror galvanometer. We proceed as follows: Charge the condenser  $C$  with the full power of the battery, and note the deflection,  $d$ ; this is the first experiment. Second. Apply a shunt of resistance,  $S$ , to the battery, and, while so applied, charge with it the condenser  $C'$ , and vary the value of the shunt  $S$  until the same deflection  $d$  is obtained as in the first experiment; then

$$B = \frac{C - C'}{C'} \times S,$$

a result like that obtained with the tangent galvanometer. The contact of the shunt need be but momentary, so that neither  $E$  nor  $B$  will have opportunity to vary much. Experiments on forty cells of gravity battery, with these two methods in comparison, give resulting values of  $B$  that do not differ from the mean so much as 2 per cent.

*Electro-motive force.*—In order to determine this element in volts, it is needful to have a tangent galvanometer of which the value,  $a$ , is known. One of the Farmer instruments in use at this station has .015 for the value of  $a$  at this station; hence, if the value of  $B + R$  be so chosen that the product  $(B + R) \times a = 1$ , the value of  $E$  will correspond or be equal to the tangent of the angle of deflection  $\theta$ . This constitutes a rapid method of working, and many of the values in Lieut. A. R. Couden's table were thus determined.

The best angle for experiments of this class is about  $42^\circ$ , ( $42^\circ 21'$ ), as at this angle the sum of the errors of reading and the tabular tangents is a minimum.

The experiments detailed in Lieut. A. R. Couden's table show that the station battery is uniform in its action, enduring in its character, and is competent for sustaining currents of the strength needful for electric light; also for firing purposes for any reasonable length of time. I may mention that forty cells of it were set up on the 13th of July, have been used for electric light as much as four or five hours, have been occasionally used nearly every day a little, and are now (November 22) ready and sufficient for use as a firing battery. A little water has been added to supply the loss from evaporation, but no chemicals have been added since it was first set up.

*Gravity battery.*—This is uniform and certain in its action, at all times ready to give a steady current, but is hardly as economical as the station battery on a closed circuit, when much current is required.

*Waffle battery.*—This is a gravity battery, and much resembles the Tray battery of Sir William Thompson. It has been used for the last year, and more for the purpose of supplying currents to "Converse indicators" which keep watch of the circuit-closers. Its performance is entirely satisfactory.

*Leclanché battery.*—Various forms of these have been under trial, and with satisfactory results. The later form of solid electrode promises well.

*Converse kerite-covered zinc cup.*—This modification is designed to furnish a battery which shall be compact and durable, able to withstand all the rough usage and abuse that may be expected on shipboard, and yet be ever ready to give forth its current.

Using the solid form of Leclanché electrode, inclosed in bunting bag and having a flexible cover, as now used, nothing seems needful to be added to it to make it the most serviceable for ship use, either as a bell or firing battery.

*Table of cost.*—The subjoined table shows the theoretical consumption, in grains per diem of twenty-four hours, in each cell, due to a current of one veber strength flowing through it, of each of the following substances, being those commercially occurring in trade, and such as are generally used in batteries :

	Grains.
Commercial sulphuric acid 66° B.....	777.6
Commercial nitric acid 54° B.....	1214.4
Crystals of sulphate of copper.....	1706.4
Pure distilled zinc.....	444.0
Peroxide of manganese.....	595.2
Bichromate of potash.....	1780.8
Pure copper.....	432.0

Using this table it is easy to calculate the cost of running a given current, with any of the cells above mentioned, when the price per pound of the materials becomes known.

It is found that owing to local action the actual consumption of zinc is greater than the theoretical; much more so when nitric acid is used in the porous cup, as in the Bunsen or Grove batteries.

Likewise the actual consumption of sulphuric acid is greater than the theoretical.

The consumption of the sulphate of copper agrees in practice very well with the theoretical demand, and so does the deposition of copper in the Daniell or gravity battery.

So, too, the theoretical and practical consumption of bichromate of potash agrees very well in the station battery, where it is simply used to regulate the nitrous acid.

The production of a given amount of energy, whether for the purpose of electric light or for other purposes, where the current is constant, seems to be more economical with the station than with the gravity battery.

In both, the largest portion of the zinc waste arises from the final bits of zinc rejected; especially is this true on continually closed circuits.

The terminal insulation of the underground wires is more than ample for torpedo purposes, but the office switch-board shows defective insulation resulting from the mode of its construction. I can but hope it may soon be replaced by one which shall better comport with the other excellent apparatus of the station.

*Siemens's cable.*—The copper-covered cables used to connect the circuit closers and buoys in the harbor to the indicators on shore have given good satisfaction.

*Circuit-indicator.*—Ten of Converse's circuit-indicators have for some six months past been connected with as many circuit closers and buoys, and the performance of these instruments has equaled the most sanguine expectations with regard to them.

*Buoy carried away in a storm.*—A severe storm occurred in March last, during which one of the buoys and circuit-closers was driven from its moorings, rupturing the cable which connected it to the shore, thus affording a practical demonstration of the value of the indicator, as the accident was immediately signaled automatically to the office, thus enabling the buoy to be recovered before it had drifted out to sea.

At another time the propeller of the launch got foul of one of the cables, and this, too, immediately caused the ringing of the signal-bell at the office.

#### DYNAMO-ELECTRIC MACHINES.

During the past year an investigation has been commenced, having for its object to determine the relative merits of several of the most noted magneto or dynamo electric machines now before the public, and their applicability to the purpose of producing electric light.

Also, an inquiry has been instituted into the cost of the electric light, whether developed by a galvanic battery or by a magneto-electric machine. This inquiry is not yet concluded, and but few of the results are ready for use.

Among the magneto-electric machines experimented on are the Gramme, the Wilde, the Farmer, and the Heffner alternate, as built by the Messrs. Siemens Brothers, of London.

*Gramme machine.*—The machine used at this station is a small one, having only about eight or nine pounds of wire on the armature, which is divided into two circuits. To each of these circuits is attached a separate commutator of 50 divisions. (A large one of 8,000 candle-power recently obtained.)

The resistance of each armature-circuit is little more than 0.3 of an ohm.

The field of force has about thirty-five pounds of wire used in its construction, disposed in four bobbins.

The aggregate resistance of the field-of-force bobbins amounts to 1.317 ohms; hence the total resistance of the machine when connected in series amounts to little more than 1.9 ohms.

It is arranged to run at a speed of about 1,800 revolutions per minute, ordinarily, and when running at this speed will give a light varying from 275 to 425 candles. The intensity of the light falls off somewhat after running an hour or more, owing to the heat developed in the armature. This is true of all such machines.

The power required to drive this machine at this velocity and with a short electric arc is somewhat less than 1 horse-power. The machine is well-made and durable—has wanted no repairs as yet. It has occasionally been driven for a short time at a much higher speed, say 2,500 or 3,000 revolutions per minute; but the heating of the coils is so great that it does not seem advisable to run it continuously faster than 1,500 revolutions per minute. At this rate it has been run continuously for as long a time as three hours, and might have been run twice as long with safety. Almost no spark appears at the commutators.

*The Wilde machine.*—This is a to-and-fro-current machine, very like the machine of Hjorth with the permanent magnets omitted, but having

two armature-circuits, one with current uniform in direction for the purpose of maintaining the magnetism of the field, the other circuit being used for the production of electric light. The current from this armature-circuit is a to-and-fro current, and of course requires no commutator, and thus avoids the spark that would occur in a Hjorth machine.

About 360 pounds of wire are used in the construction of this machine, and when run at the normal velocity of 600 revolutions per minute, it will afford from the accompanying lamp from 3,500 to 3,600 candle-lights. There are twice twelve armature-cores in this machine, and a like number of cores and bobbins forming the field of force.

The machine is inclosed in a neat wooden covering, is built substantially, and is durable.

When run continuously for some hours on a very short circuit, the armature and its cores get quite uncomfortably warm, owing to the rapid reversals of the magnetism of the armature-cores, (about 7,000 times per minute.)

An interesting experiment is often performed with this machine. Two coils of No. 12 copper wire, each coil about 3 inches diameter and about 5 inches long, are included in the lighting-circuit of this machine. Into the hollow of one of these bobbins is thrust a bar of brass, about 5 inches long and  $1\frac{1}{4}$  inches diameter. A hole drilled into the top of this bar contains, say, one-fifth of a cubic inch of water.

A similar bar of soft iron is inserted into the other coil or bobbin, and its cavity is likewise filled with water. The machine is now put in motion. In about five minutes the iron bar becomes uncomfortably hot, but the brass bar remains tolerably cool, or at least does not get very warm. On the contrary, the iron bar grows warmer, evaporates the water in it, and soon is hot enough to blacken wood if held in contact with it. All this time the coil which incloses the iron bar can be held in the hand with impunity, but the iron meanwhile is too hot to be touched with impunity. A musical note is heard produced by the reversals of the magnetism of this bar.

Something over 6 horse-power appears needful to maintain the velocity of 600 revolutions per minute when the resistance exterior to the lighting-circuit is very small.

The resistance of this armature-circuit is .074 ohm, while that of the other and smaller circuit that maintains the field is about .45 ohm—that of the field being 2.83 ohms. This machine appears to be very durable, and thus far has called for no repairs except the damages that occurred during transportation, which were slight.

*Farmer's Dynamo.*—Several of these machines have been undergoing experiment at this station within the last two years.

The first was a combination of eight of pattern A, such as are used for firing torpedoes. They were geared to run together at a speed of about 1,500 revolutions per minute, and were capable of affording as much as 5,000 candle-lights, but the internal heating was too great for long-continued service. Next was tried a single machine of pattern D. This had facilities for cooling by means of a stream of running water, and at 2,000 revolutions per minute would afford as much as 2,000 candle-lights.

About 200 pounds of wire were used in the construction of this machine.

An 8-inch machine of pattern F F has been used successfully, and gives good satisfaction. About 175 pounds of wire is used in its construction. It has four bobbins forming the field of force. The armature



has twice 25 cores. There are two commutators, having 75 divisions each. The total resistance of the machine, as usually coupled and run, is not far from 4 ohms, and at a speed of 800 revolutions per minute it produces an electro-motive force of about 120 volts in an external resistance of 3 to 4 ohms. This machine will yield as much 2,500 candle-lights at a speed from 700 to 800 revolutions per minute, and does not require more than 3.75 to 4 horse-power to maintain this service. Almost no spark is seen at the commutators, and no repairs have yet been required. Machines of this description are now manufactured by the Messrs. Wallace & Sons, of Connecticut.

*Siemens's machine.*—One of these machines, known as the Heffner alternate machine, has been supplied to this station, and many experiments have been tried with it. Its performance is very satisfactory. It is the largest and most powerful machine now in use at this station. The armature contains between 95 and 100 pounds of wire, and the 4 field bobbins contain in the aggregate some 360 pounds more. This machine is adapted to the production of a powerful current in a small external resistance, say as much as 50 to 100 webers. Often as much as 40 to 50 webers is developed during the continuance of a short electric arc, and the amount of light often exceeds 5,000 C. L. It is said to be capable of producing so much as 14,000 C. L. at a speed sufficiently rapid, but the internal heating would be too great for safety. At the normal velocity of 370 to 380 revolutions per minute, it readily yields from 3,500 to 4,500 C. L. if the external resistance of leading wires be small. This machine is well and strongly built, is not liable to get out of order, except at the commutator. The commutator brushes need occasional re-adjustment, in order to keep down the spark, which is only trivial for a current of such strength. Theoretically, we should expect this machine to give the largest duty of any of the group here described. I expect to be able to determine this point when the experiments now in progress shall have advanced far enough and shall have been properly discussed.

*Electric lamps.*—With the Wilde machine came a new automatic lamp, with reflector and stand. This lamp is simple in its construction and is well made. A right and left handed screw, each of same pitch, are used to move the carbon points to and from each other. The working of the lamp is simple and satisfactory. By means of the reflector and stand a very fair beam can be directed upon any object within its range.

*Siemens' lamp.*—With the Siemens' machine came a very ingenious automatic lamp, having with it a catadioptric apparatus, consisting of a small reflector behind the light, and a Fresnel lens in front of the lantern. This lens is near 20 inches in diameter and is of excellent construction. In the base of the lamp is a powerful electro-magnet, which, with its armature circuit-breaker and adjusting apparatus, serves to separate the carbons to proper distance for the production of the electric arc. The carbons tend to run together, from the effects of gravity upon the upper carbon holder, but they are restrained through the action of the armature of this electric magnet until, as the carbons burn away, the current weakens so far as to allow the train of wheel-work to start, when the carbons approach until the current is again of its normal strength. The construction of this lamp adapts it to currents of the strength of from 40 to 70 webers, but it is hardly delicate enough for currents so low as 8 or 10 webers, and indeed was not intended for such.

*To and fro currents.*—Another peculiarity of this lamp is a contrivance such that by turning a button in one direction it can be worked by the to-and-fro current from the Wilde machine. While by turning this button

in the opposite direction, it is adapted to work with a current uniform in direction. The mechanism by which this is done is simple, but, as here constructed, it once in a while gets out of order.

The rapid vibratory motion of the heavy armatures tends to produce some considerable wear in the mechanism.

#### FARMER'S AUTOMATIC LAMP.

This lamp differs from others in the employment of a regulator or relay to operate the mechanism through the intervention of local or branch circuits. This relay consists of an axis-bar suspended from a delicately-poised lever in such a manner that the bar is just within a coil of wire, through which the whole or a portion of the main current passes. The action of the current when too strong tips the bar in one direction, and when the current is too weak a retractile spring tips the bar in an opposite direction.

A train of wheel-work, driven by a spring, tends to cause the carbons to approach each other. The motion of this train of wheel-work is arrested by the armature of a small electric magnet, which magnet is a branch circuit or shunt to the coil first spoken of.

The tilting-bar of the lever of the regulator closes the local current of this releasing-magnet whenever the current is of proper strength, but as soon as the current weakens by the burning away of the points, the retractile spring of the regulator causes the lever to open the branch circuit of the releasing-magnet, and so its armature permits the train to move and approach the carbons until the main current again becomes of such strength that the regulator closes the branch circuit of the detaining magnet, and thus stops the motion of the train.

Should the points run into actual contact, after the arc is broken and again restored, a third electro-magnet, also in the main circuit, withdraws the lower carbon from contact with the upper, and holds it in this position until the arc is again broken.

The movement of the carbon-holder is caused by the action of two screws, so geared together that one pencil shall advance twice as rapidly as the other.

Conveniences are attached to each carbon pencil-holder, so that they can be disengaged from the screws and moved to any required position independently at pleasure. The holders also admit of separate adjustments on a vertical axis, whereby the two carbons can be placed over each other.

The spring needs rewinding no oftener than new carbons are supplied.

The performance of this lamp is entirely satisfactory. It has been run for three hours continuously, and was then stopped as the engine stopped at noon. No reason exists why it should not run continuously until the pencils are consumed, provided it be properly adjusted at first, and supposing the magneto-electric machine to run with ordinary regularity.

#### COST OF LIGHT.

Where a large amount of light, say from 5,000 to 10,000 candle-light, is required, it can be produced from a suitable machine of any one of these constructions at the rate of 1,000 candle-light per horse-power; but smaller amounts, say 200 to 300 candle-light, are relatively more expensive, say about one-half horse-power for 200 to 250 candle-light.

This is much more economical than when produced from any of the

ordinary forms of galvanic battery. One horse-power may be reckoned as costing from \$0.02 to \$0.06 per hour, which would give the cost of 10,000 candle-light as \$0.60 per hour, simply for power. Of course some other items, such as oil, attendance, interest, and depreciation, also cost of carbons consumed, would increase this amount somewhat, but even at twice or three times this cost, it is even then much less expensive than gas-light at 3 candle-light per cubic foot per hour, at a cost of \$2.50 per thousand for gas.

#### INCANDESCENT PLATINUM.

When either platinum or iridium are rendered incandescent by the passage of an electric current through bars or wires made of either metal, a mild and pleasant light is emitted, much less contracted and glaring than the light obtained from carbon pencils; with this advantage, no vitiation of the atmosphere occurs, and the amount of light at any one point can be made as small as may be desired.

Platinum affords about 100 candle-light per square inch of incandescent surface when within  $220^{\circ}$  of the point of fusion, and a bar or wire of it can be maintained at this temperature for any length of time by means of Farmer's automatic regulator, controlling a suitable current.

#### IRIDIUM,

From its higher melting-point, yields more light per square inch of ignited surface, and can also be readily maintained at any desired temperature below the point of fusion by means of the apparatus above mentioned.

#### ELECTRIC SIGNALING.

Two different classes of experiments were made in this department. The first class of experiments relate to the use of incandescent platinum bars as the source of light. Three bars or strips of platinum, each bar being about 2 inches long,  $\frac{3}{8}$  of an inch wide, and  $\frac{3}{16}$  of an inch in thickness, were arranged vertically over one another at suitable distances, say 10 feet apart.

Three resistance coils, and three continuity-preserving keys, were provided, and so arranged that pressing key No. 1 only the upper light was shown, pressing key No. 2 both the upper and middle one were exhibited, next pressing key No. 3 all three lights were shown. Thus one light should signify figure No. 1, two lights figure 2, and by combinations of these any set of signals could be produced. All three lights shown simultaneously served to denote a pause or end of word or sentence. This method can be manipulated quite rapidly.

The use of the resistance coils was to preserve the resistance of the circuit nearly uniform, the keys serving simply to substitute in the circuit the dark coil for the incandescent bar.

#### SECOND METHOD.

In this second plan the carbon-point lamp was surrounded with a lantern having a sort of venetian-blind arrangement, which could be opened or closed at pleasure. This was operated by hand; opening it for a second or two disclosed the light, while shutting the blind concealed it from view. By the use of this arrangement signals could be executed rapidly and with precision, and no difficulty was experienced in inter-

preting and recording them at a distance of eight miles, nor would any have been experienced at much greater distances had opportunity offered, in fact they were distinctly seen at the distance of twelve miles.

These experiments were considered entirely successful and satisfactory by the Chief Signal-Officer, Commodore F. A. Parker.

I approved a report by Lieut. A. R. Couden on the tests made of the various unions or splices. Likewise a tabular account of some of the battery measurements that have been made during the year. Some four different methods of measuring were the principal ones used.

No. 1 is as follows:

$S = A \tan \theta'_2 = \frac{E}{B + R}$ , where  $B$  is so small that it may be neglected

in comparison with  $R$ , hence  $E' = R \times A \tan \theta'_2$  approximately.

2d.  $R$  is removed from the circuit entirely, and we have  $S' = A \tan \theta_2 = \frac{E}{B}$  and we get  $B = \frac{E}{S'}$

$B' = \frac{R \times A \tan \theta'_2}{A : \tan \theta_2}$ . Results from this method are not as correct as from the shunt method No. 3.

Method No. 2 is as follows:

$$S = \frac{E}{B'}, S' = \frac{E}{B + R}, \text{ hence } B = \frac{R \times S'}{S - S'}.$$

Method No. 3 is the shunt method explained when speaking of methods of battery measurement.

Method No. 4 is practiced as follows:

So adjust  $R$  that  $(B + R) \times a = 1$ , then  $S = \tan \theta$  and  $E = (B + R) \times a \times \tan \theta$ . Next arrange a shunt around the galvanometer so that the tangent of the angle of deflection shall express the strength of the current  $S'$  flowing through the battery when the resistance  $R$  is removed, then  $B = \frac{E}{S'}$ .

This latter method is not as accurate as No. 3, but repeated approximate measures can be made by it with rapidity.

Various other matters of more or less interest have been experimented upon, but are here omitted for want of time to properly prepare them.

I would here take occasion to mention the fidelity with which Lieuts. G. A. Converse and A. R. Couden, also Ensign A. L. Case, jr., have assisted me in these labors. I would also call attention to the very orderly arrangement of the battery-room, due to the thoughtfulness of Lieut. G. A. Converse, and would not neglect to mention the very tidy manner in which the batteries are kept by Mr. Brooks.

Respectfully submitted by

MOSES G. FARMER,  
*Electrician.*

Capt. K. R. BREESE, U. S. N.,  
*Inspector of Ordnance, in charge of Station.*

OROUS CUP.

Weight.

1 oz ..... Fills,  
tios

Fills

Fill

1.8 oz ..... F









TORPEDO STATION, NEWPORT, R. I.,  
*November 25, 1876.*

SIR: In pursuance of your instructions, I respectfully submit the following statement. In it I have given an outline of the kind of work performed in the chemical department of this station.

The work of the chemist at a station like this is sufficiently varied, as, besides his special and peculiar duties, he naturally enters into much work and experiment of a general nature. In this sketch mention is made only of the strictly chemical work of the station. Such work is of course but a department of the main subject, and in the development of the latter has its place and part.

In the limits of an outline like this, it will not be possible to do more than indicate in general terms the directions in which work has been carried on, some of the results obtained, and some of the objects which are to be accomplished, not attempting to fully discuss matters so filled with multiplicity of detail.

During the time that I have performed the duties of chemist at this station, (since October 16, 1869,) in my particular work, I have had the assistance of Mr. T. M. Chatard, (assistant chemist January 4, 1871, to August 30, 1872,) Lieut. H. C. Wisner, United States Navy, (May 1, 1871, to January 11, 1872,) Lieut. F. M. Barber, United States Navy, (January 11, 1872, to October 15, 1874,) Dr. Geo. B. Peck, (assistant chemist August 24, 1872, to April 30, 1874,) Lieut. E. Longnecker, United States Navy, (September 2, 1873, to November 27, 1873,) and Mr. C. A. Pitkin, (assistant chemist June 15, 1874, to June 30, 1876,) and I desire to acknowledge the energy and ability displayed by these gentlemen in the duties of this department. Especially to Lieutenant Barber and Mr. Pitkin, who were the longest in this work, much credit is due.

EXPLOSIVES.

The principal part of the work of the chemical department of this station is in connection with the experimental manufacture and use of explosive bodies. All explosive substances used or experimented with, excepting gunpowder, are placed in this department, and the care and handling of them requires much time and labor.

For torpedo purposes, a more violent explosive than gunpowder is demanded. Nitro-glycerine and gun-cotton are the substances generally employed for such uses. Nitro-glycerine possesses great explosive power; and the readiness with which it may be prepared makes it easily obtainable, comparatively speaking. The experiments with nitro-glycerine at the station have been more numerous than with any other violent explosive.

NITRO-GLYCERINE AND ITS PREPARATIONS.

In the fall of 1870, two small rough buildings were constructed for making nitric acid and nitro-glycerine, but they were not fully ready for use until the summer of 1871. From that time to the end of 1875 there have been made here about 4,000 pounds of nitro-glycerine. Work of this kind is usually done only in the summer and fall. The nitro-glycerine made is used at the station for experiment, either in the liquid state or in the form of various preparations or mixtures.

The method used for making nitro-glycerine is that employed by George M. Mowbray, at the Hoosac Tunnel Nitro-Glycerine Works, at North Adams, Mass., and consists essentially of the slow addition of glycerine to a mixture of strong sulphuric and nitric acids contained in

earthenware pitchers standing in ice-water, and during this addition, the acid mixture in each pitcher is agitated by a powerful stream of cold air. After this action is completed the pitchers are emptied into a large vat of water, where the acid is diluted and the nitro-glycerine precipitated to the bottom. The diluted acid is drained off from above the nitro-glycerine and the latter removed for final washing.

This method is, I think, in many respects preferable to any other in use. If the proper materials are employed and the requisite care taken, nitro-glycerine can be made by it rapidly and of uniform quality.

The apparatus in use at the station has been altered several times as experience showed possible improvements, until in its present form it gives entire satisfaction.\*

In this apparatus the air, before being forced into the pitchers, is dried by passing through sulphuric acid. This can be readily done and is of considerable importance, for it is very essential that the acid in the pitchers should be as strong as possible, and when the large amount of air driven through each is considered, it will be found that the quantity of water so carried in is not to be neglected. Although the air is cooled before entering the pitchers, yet, unless first dried, it will carry forward a good deal of moisture.

The cooling arrangement is composed of ten spirals of small, light tin pipe laid on a grating in a box, so that they may be lightly covered with ice and salt. This is much preferable to exposing the air to direct contact with ice. Better cooling can be obtained and the air is kept dry.

This apparatus is provided with a simple but effective arrangement for removing the fumes, so abundantly evolved during the operation. As at first built, the troughs were open, so that the acid and excessively irritating fumes were given off directly into the room, and this method has been the usual one, greatly to the injury of the health of the workmen employed.

In January, 1873, a draught arrangement was tried, which worked fairly well; but the troughs were so placed that it could not be readily applied, and in June, 1874, a new apparatus was contrived, which has answered all requirements. In this the troughs are placed around a chimney, and over them are hoods, slanting up toward the chimney, into which they open. A small fire in a grate on the floor below gives a powerful draught up the chimney, which draws a current of air across the tops of the pitchers, sweeping off the fumes and discharging them into the open air. Usually, no fire is required, the natural draught being sufficient. The advantage of this is very great, as the air of the room in which the work is going on is entirely free from fumes, and the workmen can without difficulty remain close by the pitchers, watching them carefully.

The station apparatus has six troughs, containing four pitchers each, and in it one hundred pounds of nitro-glycerine are made at a time. Two workmen are required, and two runs can be made in one day when necessary. A larger apparatus could be operated by the same force, if it was desirable.

#### MATERIALS.

The glycerine used for making nitro-glycerine is the commercial article of good quality. Absolutely white glycerine is not essential; but it must be free from fatty acid and contain but little water. Good glycerine can be readily obtained from many American makers, and

\* In the bureau publication, "Notes on Explosives," by W. N. Hill, is given a full description of this apparatus with drawings.

indeed, the glycerine made in this country is generally better than the imported. The German glycerines are apt to contain fatty matter.

I have had but one case of seriously bad glycerine, and that was, as nearly as I could find out, of American make. This glycerine was purchased in 1872, and was found to be largely adulterated with dextrine or similar products. It was probably intended for calico-printers' or paper-makers' use. Especial pains should be taken to see that the glycerine for making nitro-glycerine is of good quality. If impure, there is a strong probability that the nitro-glycerine made from it will be dangerously sensitive, as well as of inferior explosive force. At one time I tried some glycerine which was not adulterated, but was of inferior grade, and the nitro-glycerine made from it was extremely difficult to purify, and was more sensitive than the nitro-glycerine made from the better material. The glycerine should always be tested before use.

The sulphuric acid used is the ordinary oil of vitriol of commerce.

The nitric acid is all made at the station. As far as I am aware, nitric acid of the proper strength (not less than 1.45 specific gravity) cannot be purchased in this country, and it is very necessary that the nitric acid should be of full strength.

Nitro-glycerine is much more readily made than gun-cotton, and it is possible to use weaker acid; but a great mistake is made in doing so. By using the weaker nitric acid a nitro-glycerine of inferior quality is made, and one more liable to decomposition and accidental explosion. Yet it is to be feared that many of the manufacturers neglect this important point, and content themselves with the weaker acid on account of its cheapness. Certainly much of the nitro-glycerine made and sold is bad and dangerous, as is shown by the many terrible accidents with it or preparations containing it. It is certain that good nitro-glycerine cannot be made without the strongest acids.

#### NITRIC ACID.

Nitric acid for making nitro-glycerine has been generally prepared at the station by careful distillation from soda, saltpetre, and sulphuric acid, in an iron still. An excess of sulphuric acid is used in the still, and the operation is conducted slowly, at a moderate temperature.

The still is cylindrical in form, and so placed in its setting that the heated gases from the fire pass twice completely around it, so that it is uniformly heated. The product of distillation is received in oil of vitriol in stoneware receivers. In this way, by taking pains, strong acid can be prepared; but the method is hardly satisfactory, as there are serious objections to it. It is slow and wasteful, as the loss is large, and in constant use the stills wear out fast. It would be much better to distill in earthenware stills from nitrate and sulphuric acid, or in earthenware or glass, from sulphuric acid and common nitric acid.

A furnace for the latter method has been prepared, but there has been no chance to use it as yet. For the comparatively small amount of nitro-glycerine made here, the arrangement for distillation at first put up has served tolerably well, but it would be very desirable to replace it with a better, if further work of this kind is to be done.

The nitric acid distilled is, as mentioned above, received in sulphuric acid, so that at the close of the operation a mixture of the two acids is drawn from the receivers. This mixture may be used directly for making nitro-glycerine, but it varies considerably in composition at different times. If the distillate was obtained in quantity and quality approximating to the theoretical proportions, it would be only necessary to put

into the receivers the right amount of sulphuric acid to obtain the mixture required. But in practice there is a varying but considerable loss, and there is always a little water present, so that no two lots are alike. It will not do, as is customary when this method is employed, to depend on the hydrometer indications for the character of the mixture. It is very evident that a mixture of much sulphuric acid, little nitric acid, and some water can mark the same number of degrees on the hydrometer as a mixture containing sulphuric and nitric acids only. It is necessary to determine the actual proportion of sulphuric acid, nitric acid, and water present. This is easily and quickly done by diluting a weighed quantity of the mixture to a definite bulk and titrating one measured portion by standard alkali and another by barium nitrate or chloride. The impurities (water, &c.,) are obtained by difference. More sulphuric acid is added to the mixture, if needed, and the latter is used in the pitchers of the nitro-glycerine apparatus in such quantities as is required to furnish the proper proportion of acids to glycerine. In this way the yield of nitro-glycerine for the glycerine used is rendered uniform.

During the operation of conversion the temperature is kept as low as possible by cooling the pitchers by ice-water and by the cold dry air used for agitating. When properly conducted there is no difficulty in doing this.

#### WASHING.

After its precipitation in the large vat, the nitro-glycerine is thoroughly washed by decantation. The washing is performed with the aid of an air stream, which breaks up the heavy oily liquid and spreads it through the water. For the intermediate washings sea-water may be used if desired and fresh water is scarce; but the precipitation, the first and the last two washings, should be made with fresh water. The washing is continued until complete. I have not followed the plan of using an alkaline liquid to remove acid clinging to the nitro-glycerine. This seems to me as bad work. It is possible to wash the nitro-glycerine free from acid with water, and it is much better to wash thoroughly than to trust to the use of an alkali in order to diminish the amount of washing necessary. The acid is but slowly removed, and to accomplish the removal requires long washing. I have found that with sufficient washing, nitro-glycerine can be perfectly freed from acid and remain so for more than four years. When nitro-glycerine is to be kept in the liquid state, it may be desirable to add a little alkaline carbonate to the water over the explosive, to neutralize traces of acid which may appear, although there ought to be no necessity for doing this. But nitro-glycerine, which is to be employed in making the solid or semi-solid preparations now so commonly used, ought to be surely freed from acid, when made, by thorough washing.

Nitro-glycerine, as first precipitated, is a creamy-white opaque liquid, but on standing at a moderate temperature it becomes transparent and thinner.

#### THE "CLEARING" PROCESS.

The "clearing" process is one of value to the maker, and should be watched carefully. Care must be taken that the precipitation is performed in a large excess of water to avoid rise of temperature, which affects the condition of the nitro-glycerine. In warm weather, it is best to put some ice in the water of the precipitating vat. If the washing is thoroughly done, it will be found that, as the clearing goes on, no acid.

or but a faint trace of acid, appears in the water above the nitro-glycerine; but if it has been imperfectly done, the presence of free acid will be plainly indicated. During clearing, the water above the explosive should be frequently changed and examined for acid.

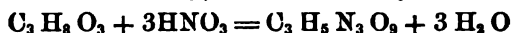
The time required for nitro-glycerine to become clear varies, according to the temperature, from ten days to two or three weeks. It may be hastened in cool weather by keeping the jars containing the nitro-glycerine in water at 60° to 70° Fahrenheit; but, when possible, it is better to allow time for it to go on slowly.

If the explosive clears without showing signs of free acid, it will remain so indefinitely.

In the magazine at the torpedo-station are more than forty samples of nitro-glycerine, made in the course of work in the last five years, which have shown no signs of change or acid reaction during the various times they have been in store, although they are kept without special precautions and exposed to extremes of temperature.

#### PROPORTION OF PRODUCTION.

The proportion of nitro-glycerine obtained to the glycerine used is about 1.75 to 1. Theoretically, if the equation;



correctly indicates the formation of nitro-glycerine, the product should be 2.46 parts of nitro-glycerine to 1 of glycerine. In practice, of course, there would be some loss, as the glycerine is not anhydrous, and some nitro-glycerine would be lost in handling. But, in addition, there are secondary actions, by which part of the glycerine is converted into soluble products, which are washed away.

In a series of experiments in the laboratory, using anhydrous glycerine and the strongest acids in excess, I obtained 1.92, 1.89, 2.03, and 1.93 parts of nitro-glycerine to 1 of glycerine, an average of 1.94 to 1. The product of 1.75 to 1 approaches as near to the above results as a working operation can be expected to do.\*

It is also possible that the action indicated by the equation above written is not the only substitution which goes on, and that others enter into the reaction, but this I will touch upon beyond.

#### APPEARANCE.

As already remarked, when freshly made, nitro-glycerine is an opaque creamy fluid which afterward becomes transparent. It has been said that the original appearance of the substance is due to water entangled in it, and that on standing the heavy nitro-glycerine gradually separates from the water, assuming its natural condition. I am inclined to doubt this, and to believe that the change is really of a chemical character. It may consist of a separation of water, but this water must have been in combination, like a water of crystallization. Certain salts (crystallized calcium chloride, sodium chloride, &c.) cause the change to occur rapidly, but this might be in either case. A low temperature hinders, or, if low enough, even prevents, the change, which would not probably be true if the water was simply mechanically held. Further, I have seen

\* Champion and Pellet (Bull. Soc. Chem., XIX, 494) found that 100 grams. chemically-pure glycerine yielded 190 grams. of nitro-glycerine, and remark that careful attention to strength of acid, the temperature, and all other details is necessary to insure constant results, which is indeed very true.

the opaque nitro-glycerine frozen distinctly crystalline. I have also often noticed that at different times nitro-glycerine which has been cleared will be by turns clear and turbid without cause other than atmospheric influences. This would take place in nitro-glycerine covered with water and in that which was free from water. An examination into this subject has been projected, but there has been no opportunity for carrying it on.

When perfectly pure, cleared nitro-glycerine is colorless, but generally it has a slight amber or pale-yellow tint. It dissolves quite freely in absolute alcohol, and in less proportion in weaker alcohol. From the alcoholic solution water precipitates it colorless.

#### FREEZING.

A large number of observations have been made on the freezing of nitro-glycerine in various conditions, but they cannot be detailed here. Frozen nitro-glycerine is incapable of being exploded, as is well known, yet there are cases on record where it is said to have been exploded by blows when solidly frozen. This is but one of the instances of very different properties assigned to this body by different persons.

#### COMPOSITION.

It is very evident from these varying statements that the same material is not referred to in all cases, and it becomes a question of great importance to determine if the nitro-glycerine used as an explosive is a body of uniform composition, a mixture of several substances, or whether it is liable to be contaminated with impurities which affect its properties. The equation  $C_3H_5O_3 + 3HNO_3 = C_3H_5N_3O_9 + 3H_2O$  is written on the view that nitro-glycerine is trinitrin,  $C_3H_5(NO_2)_3O_3$ , but, as has been shown by L. Henry, there are probably two other such substitution products of glycerine or nitrins,  $C_3H_5(NO_2)_2O_3$  and  $C_3H_7(NO_2)_2O_3$ . The two lower nitrins would, of course, be less powerfully explosive than the trinitrin, and would differ from it in other ways. If these are formed in the nitro-glycerine reaction, it would probably be when weak nitric acid is used, since, in similar cases, the degree of substitution is usually dependent upon the strength of the acid employed. It is also very probable, as in many analogous cases, these lower products are less stable than the higher. It would be a work of the highest importance and interest to study the nitro-glycerine reaction, and to ascertain if one or more nitrins are formed in it, and the conditions of their formation. Some time since (1874-'75) I began experiment in this direction, but owing to pressure of other work have been unable to continue it as rapidly as I could wish. Recently, however, I have been able to return to it, and hope in the coming year to carry it on more steadily and to a conclusion. The part I am now engaged upon is the action of sulphureted hydrogen and alkaline sulphides on nitro-glycerine, hoping to be able to use such a reaction analytically on various nitro-glycerines.

Decomposition readily takes place when an alcoholic solution of an alkaline sulphide or sulphurate is added to an alcoholic solution of nitro-glycerine. It might be expected that the action of the alkaline sulphides would reproduce glycerine with the formation of an alkaline nitrate, and this seems to occur under certain conditions, although the decomposition is evidently not as simple as by this hypothesis.

The action of sulphureted hydrogen seems to be very different. From an alcoholic solution of nitro-glycerine which has been acted upon by

sulphureted hydrogen, after some time, long white needles separate out. This body is under examination.

It is of interest to call attention to the possibility of making use of the crystallization of nitro-glycerine as a means of purifying it or separating it from other bodies. If nitro-glycerine be kept at a temperature near its freezing-point it begins to separate out in crystalline form, and with a little care well-defined crystals of good size may be obtained. Frozen nitro-glycerine is a crystalline mass, and by partially thawing distinct crystals may be separated. There are also differences in the readiness with which crystallization on cooling takes place.

#### HANDLING AND USE OF NITRO-GLYCERINE.

In handling nitro-glycerine the chief difficulty experienced is the inconvenience of its liquid form; but with proper facilities this may be reduced to a minimum. When it gets accidentally spilled it may be decomposed and rendered harmless by the use of a solution of an alkaline sulphide. I have found such a solution to be very serviceable. It may be readily made by dissolving flowers of sulphur in solution of sodium carbonate. In this laboratory it is called "sulphur solution." When nitro-glycerine has been spilled, after wiping it up as completely as possible, the remainder may be gotten rid of by allowing this solution to remain upon the spot for a considerable time. Glass and porcelain vessels may be cleaned with it from adhering nitro-glycerine.

There does not seem to be much danger connected with the ordinary handling of nitro-glycerine, that is, in washing, storing, and working it up into preparations for use. Pure nitro-glycerine is not sensitive to any treatment it can receive in ordinary careful handling, but when impure it may become extremely sensitive even to slight actions.

While at the station nitro-glycerine has not been extensively made, yet sufficient has been done to show what is possible, and there has not been any accident or trouble with it. During the part of the year when such work is performed, it often happens that nitro-glycerine-making is carried on quite steadily for some time, and as we send none away we frequently keep liquid nitro glycerine and nitro-glycerine preparations in store for a long time.

What work of the kind is done is on a manufacturing scale, and with a slight increase of plant and steady use of it, large quantities of the explosive might be turned out. At various times in seven months of 1875, 1,600 pounds of nitro-glycerine were made at the station, and from 100 to 600 pounds were usually on hand in the liquid state; while of dynamite and other preparations we had about 1,000 pounds in magazine.

In addition, experimental work with nitro-glycerine in some form has been constantly going on; and freedom from accident or annoyance is due, I think, mainly to the pains taken to make a pure article.

For use for torpedo purposes, liquid nitro-glycerine is inapplicable, although we have used a good deal of it in certain kinds of experimenting. The solid nitro-glycerine mixtures are the practical forms in which it is employed. But in all these, nitro-glycerine is the basis and the real agent whose power is employed, and first of all comes the consideration that the nitro-glycerine should be good; otherwise a safe and satisfactory mixture cannot be made from it. There are many forms of the nitro-glycerine mixtures, but for general purposes the simplest is the best.

## DYNAMITE.

Dynamite presents the most advantages. Much experimenting has been carried on at the station upon different dynamites made from various absorbents, with very satisfactory results. The requisite preparations have been made for the use of such an agent for torpedo purposes, when required.

The dynamite made here seems to be well fitted for use as an explosive agent in torpedoes. It contains 75 per cent. of nitro-glycerine, and yet is quite dry and readily handled, while it has shown no tendency to drop its nitro-glycerine at any temperature to which it has been exposed here. We still lack experience of it under more trying circumstances and with longer exposure. Measures should be taken for gaining this desired knowledge.

The direct action of water upon this dynamite depends upon the amount of water present. It can take up much water and lose little or none of its nitro-glycerine; but if it be acted upon by an excess of water, part of the nitro-glycerine separates. But with a dynamite less rich in nitro glycerine, this effect diminishes, until a 60 per cent. dynamite is hardly affected at all.

There has been much experiment at the station with nitro-glycerine and dynamite upon the methods of using them. Many different kinds of fuses have been tried. Liquid nitro glycerine can generally be exploded by fuses charged with gunpowder, but not with certainty, and with diminished violence. Such fuses should have strong copper or brass cases, and not be too heavily charged. The present service-igniter is much more sure to fire nitro-glycerine than the older wooden case igniter. Of course, a detonating fuse charged with fulminate is the only one which *ought* to be used to fire nitro-glycerine. There is no certainty that one charged with gunpowder will accomplish explosion, but, if used, it should be one which will give as sharp a blow or shock as possible.

Dynamite is fired by gunpowder fuses with no more certainty than nitro-glycerine, and with feebler effect than by detonating fuses. As in the other case, the powder fuse or igniter must have a strong metallic case. The best results were obtained with 15 to 20 grains of rifle-powder, but the best are unsatisfactory. In these experiments, many singular effects have been obtained; but, as the work is still in progress, they cannot be properly discussed now.

It has been already remarked that frozen nitro-glycerine cannot be exploded. Nitro-glycerine, being a liquid, freezes to a solid mass, and if detonating fuses are placed in the liquid before freezing takes place they may be afterwards fired and the frozen nitro-glycerine broken up and scattered without explosion.

With dynamite the conditions are considerably different. Properly made it is quite dry and loose in its ordinary condition, and when it freezes it remains loose and pulverulent. In this state it may be nearly always exploded. If especial pains are taken to get it into a very fine, loose powder, it is almost sure to explode, but as it approaches more nearly a dense, solid mass, it is less certain that explosion will occur.

In a large number of experiments which I have made I have found this to be the case. Sometimes, even, it seemed that the looser portion of the charge has been fired while the more solid escaped explosion. If the dynamite is soft and damp, so that it will pack closely, or if driven hard in the case before freezing, the explosion becomes still more uncertain.



Differences may be noticed in readiness of firing in the frozen state in different lots of dynamite of the same strength of nitro-glycerine. Probably these are due to differences dependent upon variations in the absorbent. In these experiments detonating fuses were used. In all cases of firing frozen dynamite it is noticeable that the violence of the explosion is much less than that of the unfrozen, and it is generally accompanied by flame and smoke, indicating a slow or imperfect combustion. Further experiment in this direction, with different modes of explosion, is of importance, and is to be carried on at the earliest opportunity.

Comparative experiments on the force of explosive agents are of a very interesting nature. There is a great want of some good method of comparing these bodies, especially those which are usually called detonating. A series of experiments with different explosives was projected and begun, but from want of time and means it has not been extended far enough to arrive at any definite conclusions. It is strongly desired that these experiments may be continued, for the methods promise to yield good results.

In the summer of 1874 some experiments with large charges of nitro-glycerine in varying depths of water were made, and it was intended to continue them and extend them to other explosive agents, using the nitro-glycerine experiments as a means of comparison. Unfortunately there has been no opportunity to do this, but the plan is worthy of a full trial, for useful practical results will be derived from it. Not enough experiments have been tried to permit drawing any positive deductions, but those that were made seemed to point to curious and valuable conclusions.

#### GUN-COTTON.

The compressed gun-cotton made by Abel's process is the only form of this agent of value for torpedo purposes. A quantity of this gun-cotton, made in England, is at the station, which was obtained for experimental purposes, but as yet little has been done with it. It is intended to be compared with dynamite. This explosive has not been made in this country, although it seems to present many advantages for blasting and for military purposes.

At the station small amounts of long-stapled gun-cotton are made for certain special uses; the 1.5 nitric acid required is distilled and a product made with not over 5 per cent. soluble in ether and alcohol.

#### FULMINATING MERCURY.

The fulminating mercury, required at the station is made in the chemical laboratory. At one time a good deal was used, as the service-igniters were charged with a mixture of mealed powder and fulminating mercury; but there were many objections to this method, with no compensating advantages, and it was afterward given up, and now fulminating mercury is only used in detonating fuses, (for nitro-glycerine, dynamite, and gun-cotton.) Trials were made of different modes of preparing this body. Four were compared:

1. Ordnance Manual, (1861.)—Ten oz. of mercury dissolved in 5 lbs. of nitric acid, sp. gr. 1.4. Pour solution into 6.675 lbs. of alcohol, sp. gr. 0.85. Add alcohol if reddish fumes appear.

2. Chevalier.—One part mercury dissolved in 12 parts nitric acid, sp. gr. 1.3; mix with 11 parts alcohol of 85 to 88 per cent. Heat over water-bath to ebullition. (Liebig directs the use of nearly the same proportions, but with some changes in mode of operating.)

3. Ohaudelon.—One part of mercury dissolved in 10 of nitric acid, sp. gr. 1.4, and 8.3 parts of alcohol, sp. gr. 0.83.

4. Howard.—One part of mercury to 5 of nitric acid, sp. gr. 1.3, and 10 of alcohol, sp. gr. 0.85.

The first method has the drawback of calling for unusually strong nitric acid. The amount of fulminate obtained usually was about equal to the mercury used, or fell slightly below it, and there was a greater tendency to the re-formation of metallic mercury than with the second method, which gave the best results, and was the most easily managed of the four. The acid is the ordinary, strong acid of commerce. The product obtained was larger than in the other cases, varying from 1.1 to 1.24 parts of fulminate to 1 of mercury used, and the tendency to form metallic mercury is less and more easily prevented. The third was more troublesome than the first and second, and in every way less satisfactory. The product by it averaged 0.92 part of fulminate to 1 of mercury. The fourth was useless, the difficulty being in the insufficient quantity of acid taken. No fulminate, or but little, is obtained, unless more acid is added during the operation, and then the amount is small.

In several cases where this method was used, instead of fulminate there was a voluminous deposit of a white substance. This substance is not fulminate, as it is non-explosive and contains nearly 79 per cent. of mercury. It is unstable; sometimes decomposing in the dry state; insoluble in water; blackened by sulphuric acid, with slight explosion; dissolved by hydrochloric acid on long heating; dissolved by nitric acid with the aid of heat and with the evolution of red fumes; *in vacuo* over lime it lost weight constantly. Further examination of this substance had to be postponed at the time it was observed, but I shall return to it in a short time. The formation of this white substance has also been noticed in the use of the other methods, but rarely, and when the solution had not been sufficiently heated. It could usually be overcome and fulminate formed by adding more alcohol and heating to active ebullition.

I attempted to simplify the operation of making fulminate by preparing a large quantity of the mercury solution beforehand, so that when it was to be done, it would be only necessary to add a measured quantity of the solution to the proportionate volume of alcohol, and thus save the trouble and delay of weighing out and dissolving the mercury each time. I found, however, that this does not work well. The mercury solution which has been kept for some time is inferior to the freshly-made, giving a reduced yield of fulminate and a greater tendency to the reproduction of mercury. It is best to mix the mercury solution and alcohol cold, and then to place the vessel in boiling water and start the action as quickly as possible, not removing it until a strong reaction has begun. Sometimes there is a delay in the starting of the action, and it will often be found at such times that the addition of a little cold alcohol causes it to take place at once.

Fulminating mercury, as is stated, can be recrystallized from boiling water, but if boiled in water for some time it is slowly decomposed with the production of mercury oxide.

#### PICRIC POWDER.

Certain of the picrates have been proposed as ingredients in explosive mixtures. Potassium picrate has been so tried, but its use has not become extensive.

Ammonium picrate has been employed by Brugère and by Abel, mixed with saltpeter.

Some experiments in this direction have been made at the station, with the object of preparing a powder for torpedoes and shells, which should be stronger than gunpowder, but equally safe and with similar properties. The ammonium picrate used was prepared from picric acid and ammonia. It is a salt readily made, and which crystallizes well, dries easily, and has no deliquescent property.

Although inflammable, ammonium picrate is almost devoid of explosive properties, and must be mixed with some oxidizing agent in order to obtain the extremely rapid combustion necessary for explosion. Saltpeter is, of course, the best suited for the purpose. The ammonium picrate and the saltpeter are soft, easily pulverized substances, and a mixture of the two salts has no cohesive property, so that it cannot be worked like gunpowder, unless some substance is added which will give the desired cohesive power. In our experiments charcoal was used.\*

The mixture was composed of ammonium picrate 42.18 per cent., saltpeter 53.97 per cent., and best alder charcoal 3.85 per cent. This was moistened with water, worked under the wheels, granulated, &c., as in the ordinary gunpowder processes. The powder obtained had a yellowish-green color, granulated well, and gave no difficulty in working.

The first trial was intended principally to test the method of operating, and was therefore very satisfactory. On comparing this picric powder with gunpowder it was found to have a force of nearly 1.75 to 1. This was determined by finding the charge of each required to burst cast-iron spherical shells. The picric powder, however, seemed to burn imperfectly, giving off a heavy, greenish yellow smoke. This was due partly to the fact that it was worked under the wheels but a short time; but it is also evident from an examination of the proportions used that the saltpeter was probably in insufficient quantity. I thought at the time of making that this might be the case, but for several reasons did not then alter the proportions, particularly as it was mainly desired to find the proportionate amount of charcoal which would be required in it.

It having been shown that this powder could be made by ordinary gunpowder processes and that it was considerably more powerful than gunpowder, it was proposed to continue the experiment by improving the proportions by adding more saltpeter, with the expectation of increasing the relative force of the powder, and for further trials a quantity of the ammonium picrate has been prepared in the station laboratory, but it has not yet been worked up into picric powder.

The picric powder which has been made is not more sensitive to blows, friction, or other treatment than ordinary gunpowder. It is perhaps somewhat softer. I have made its hygroscopic properties a subject of experiment, and have found that under ordinary conditions of exposure, as open in the air of a store-room, it absorbs much less water than gunpowder under the same circumstances. (Brugère arrives at the same conclusion. Abel states that picric powder is not more hygroscopic than gunpowder.)

I also placed samples of picric powder and gunpowder in a very damp place, although the powders were protected from direct contact with water. Under these conditions the picric powder absorbed more water than the other, though both became wet and pasty; but this difference was really due to the fact that the two powders were from different

\* Brugère speaks of charcoal as an ingredient in war-powder containing ammonium picrate; but Abel does not state how he prepared his picric powder so that it could be granulated.

makers and had different kinds of charcoal; for on comparing ammonium picrate with the same gunpowder in the same place the former absorbed but  $\frac{1}{2}$  of 1 per cent. of moisture, while the latter took up more than 10 per cent.; so that ammonium picrate does not confer upon the mixture any deliquescent tendency.

This is of importance, since it is feared that by the action of moisture attracted, double decomposition would be caused with the production of potassium picrate and ammonium nitrate. This fear would seem to be groundless, since in the manufacture the powder has been well dampened without producing any such change. Further, if there was any tendency of this kind, it would go on very rapidly, since the ammonium nitrate is highly deliquescent, whereas this powder is not strongly hygroscopic.

Whether this powder will bear keeping and handling as well as gunpowder can only be shown by longer trial of it.

A large number of experiments have been made with this picric powder as a charge for fuses and igniters, and with good results, excepting that the imperfect burning already spoken of is marked. It is possible that for such use this powder may be well suited. The experiments with this material are to be continued at the first opportunity.

#### MISCELLANEOUS EXPLOSIVE WORK.

Much attention and labor have been devoted to the subject of fuse and priming compositions, particularly at the time when frictional machines, magneto-electric machines of high tension, and mechanical arrangements were used as means of exploding torpedoes, and several compositions were prepared which were found to work well; but since the use of machines of low tension and galvanic batteries has become extensive they have been largely displaced and are rarely made.

Many other kinds of explosive and firing-bolt compositions have been experimented upon with varying results.

Experiments with igniters and fuses of various forms and for various purposes have been numerous.

In relation to modes of producing detonation there is opportunity for much experiment, and from it valuable practical results may be expected. Abel has shown that gunpowder may be more violently exploded by a detonating fuse than by an ordinary ignition. Roux and Sarrau have used a violent explosive as the fuse-charge.

I have fired gunpowder with great violence, using small amounts ( $\frac{1}{2}$  to  $\frac{1}{2}$  ounce) of dynamite as the means of explosion. It is important to ascertain if with fuses of this sort it is possible to obtain much better effects from gunpowder in torpedoes than when it is fired in the usual way.

#### LIQUID CARBONIC ACID.

The subject of making liquid carbon dioxide on the large scale for use as a motor for locomotive torpedoes, has received considerable attention.

Trial has been made of an apparatus for this object, invented by the writer in 1873, which has proved very successful.

This apparatus is a combination of a generator in which the carbonic acid gas is evolved from marble-dust and sulphuric acid with a compressing-pump driven by steam, which receives the gas from the generator at a high pressure and compresses it up to the point of liquefaction. Two generators are used, to be worked alternately, so that while

one is delivering gas the other is being cleaned out and recharged. These generators are of cast iron, of the kind used for generating carbonic acid gas for the manufacture of soda-water. From the generators the gas passes to an iron receiver, which serves the purpose of catching anything which may be accidentally carried over from the generators and also as a reservoir of gas. From the receiver the gas passes through a large coil of lead pipe which is placed in a tank where it can be cooled by the waste ice, and from the coil through a felted pipe to the compressing pump. The gas is taken into the pump at a pressure averaging 100 pounds to the square inch, and by it carried to a pressure of from 400 to 900 pounds, according to temperature. The compressed gas passes through a pipe to a receiver, which is surrounded with a mixture of ice and salt, and in this receiver the liquefaction takes place.\*

The prominent feature of this apparatus is the delivery of the gas to the compressing pump at a high generating pressure. In this way great advantage is gained. The work of compression and consequently the heat evolved by compression are very much less than if the gas were taken at the ordinary pressure, and it becomes possible to liquefy large quantities of gas in a short time. As the pressure of generation is not excessive the gas can be prepared in large generators.

The liquid gas can be made at a moderate cost in this way, since the cheapest materials may be used and the operation rapidly performed.

For reasons which will be stated beyond, for a long time it was not possible to make use of this apparatus, but there has been made with it more than 5,000 pounds of the liquid. The rate at which it can be run is about 60 pounds per hour, including all work, (getting steam, material, &c.,) but when in steady use it reaches 80 pounds per hour. I have made 466 pounds in 5 hours and 5 minutes actual operation and 8 hours total working time, which includes everything incident to starting and stopping work, and at another time 706 pounds in 8 hours and 20 minutes actual running and 11 hours full working time. It has in practice done much better than I had expected.

Experience with this apparatus has not shown any important alteration necessary. Some little additions in the way of means of handling the materials used in it would facilitate work with it. It seems to be all that can be desired for an apparatus to be permanently located in a place where the coal, ice, and other materials (acid, marble-dust, and water) can be easily obtained as at this station. This apparatus is larger than is perhaps actually necessary, and might be made considerably smaller and lighter, and yet have capacity enough for any probable requirements.

If it was desired to have an apparatus which could be readily transported, it would probably be necessary to have recourse to a simpler arrangement, based upon Thilorier's method of liquefaction by the pressure of generation, although from the much greater difficulty and cost of working with it Thilorier's plan is not nearly as good as the one which has been considered. Mr. Lay uses an apparatus on the Thilorier principle, but there are many objections to the manner of its construction. A better one could be built if it was required.

In making liquid carbonic acid with the apparatus used at the station, or one on Thilorier's plan, (such as Lay's,) large quantities of ice are needed. This is a serious drawback to the application of liquid carbonic acid to torpedo purposes, as it will often be very difficult, if not impossible, to get ice at the stations where the apparatus might be wanted for

\* A full description of this apparatus, with drawings, is given in the bureau publication, "Liquid Carbonic Acid," by W. N. Hill.

such use. I believe, however, that my method may be modified so as to avoid the use of ice altogether, and I have designed an apparatus for accomplishing this result, (see "Liquid carbonic acid," page 22.) The arrangement is simple and promises to be successful. If it is, the whole apparatus may be mounted on board ship and operated there at any time. Such a vessel would have to carry for this use marble-dust and sulphuric acid only. There would be little difficulty in doing this on a specially fitted vessel, and locomotive torpedoes would hardly be handled from any other.

For a motive power for locomotive torpedoes, liquid carbonic acid has many advantages over compressed air or ammonia, and if it can be made as readily as claimed above, I think it will be preferred to either in certain forms of those weapons; although for others different means of propulsion will doubtless be better fitted.

Another branch of the same subject has also been quite thoroughly worked out. The tension of liquid carbonic acid at the temperature at which it is kept and used is very great, (73.8 atmospheres, or 1,107 pounds at 86° Fahrenheit, according to Regnault,) and very strong vessels are required for preserving it. When the new apparatus previously spoken of was finished, it was at once put in use, and the receivers for containing the liquid belonging to the Lay torpedo at the station were filled. Shortly after the completion of this work one of the receivers or flasks burst explosively. Fortunately no one was injured, and no very serious damage was done; but the occurrence led to the condemnation of the flasks as too weak and of undesirable construction.

It was necessary to obtain stronger vessels. After careful examination it was decided to try a method of making flasks by building them up from pieces of sheet steel, and six of these flasks have been constructed for the station by John Matthews, of New York, the inventor of the method, the supervision of the work on the part of the station being in my charge. Of course this required considerable time, during which no use could be made of the apparatus.

The method consists, essentially, in forming a cylindrical vessel with rounded ends from sheets of thin steel, solidly fastened by means of pure tin. The cylindrical part is made from cylindrical shells rolled up from the sheets fitted together in numbers sufficient to give the desired thickness of walls, and finally turned into a single piece by the tin. The heads are formed from cup-shaped pieces of steel struck up from the sheet, which are put together with tin also, and the finished heads are placed over the ends of the cylinders, and fastened on with tin. (The full details of this new and interesting method of building up vessels capable of withstanding enormous pressures are given in the bureau publication "Liquid carbonic acid," already referred to.) In this way may be built up a receiver of any desired thickness and strength. In the course of trial of the method these receivers have been exposed to very severe strains, which they have borne perfectly. One of those made was tested to destruction, giving way under a hydraulic pressure of 3,136 pounds to the square inch. It had but four layers of steel of .045-inch thickness, and was 13 inches in diameter.

Evidently, from the manner of its construction, such a vessel is not likely to burst explosively, but if strained beyond its endurance will gradually yield; the sheets separating and allowing the pressure to escape. Indeed, during the working out of the methods of manufacture, it happened that flasks have shown that they were not perfectly put

together, and under trial the weakness showed itself in this way. It is easy to test thoroughly their strength before use.

Of course it has required much thought and experiment to work out an entirely new process like this, but it has now been quite satisfactorily accomplished, and it may be safely stated that by this method receivers to sustain great strains may be surely made. Some minor points of the manufacture yet remain to be decided by longer trial of the vessels already made and by experience in making others.

From the possession of the apparatus above described, the station has facilities for making very easily large quantities of liquid carbonic acid. This is an unusual opportunity for scientific experiment of a very important and deeply interesting character. On the liquid itself there is a wide field for experiment. In one direction I have already submitted a plan which deserves attention. This involves an extensive series of observations of the tension of its vapor at different temperatures, and its behavior under varied conditions. This subject will repay study, especially with the means of operating on a large scale which we have. Other valuable investigations with its aid may be made. Professor Henry has suggested one on the magnetism of metals at low temperatures. I would make special mention of these matters, as subjects which should be experimented upon here. Also I would recommend that scientific experimenters, who desire to study kindred topics, may be allowed the use of the apparatus and other means at the station of this kind.

#### INSTRUCTION.

The instruction of the officers ordered to the station for that purpose makes up a large part of the duty to be performed. Eight classes have been here since November 1, 1870. The course pursued has varied from time to time with the varied requirements and means at hand. The instruction in chemistry given to the last class has consisted principally of two courses of weekly lectures, of two hours each, one on general chemistry and the other on explosives.

In the lecture on explosives, the chemical relations of and the methods of manufacturing and handling the different explosive bodies are treated of with their special adaptation to torpedo and other military uses. Both these courses of lectures are illustrated by experiments and the use of diagrams and drawings projected upon a screen with the calcium light.

The officers attending are expected to take notes, and each week a series of questions based upon the lectures are given to them, which are to be answered by each one in a book specially intended for this use, which is examined and corrected by the instructor.

The following examples of questions given out at different times will show the method followed :

Week ending July 14, 1876.

##### Chemistry :

1. Ammonia and ammonium salts.
2. Fluorine and hydrofluoric acid.
3. Chlorine ; preparations, properties, and uses.

##### Explosives :

1. Gunpowder ; breaking down and pressing ; granulation, glazing, or finishing ; drying.
2. Tests of gunpowder ; value of eprouvette testing.
3. General composition of gunpowder.
4. Products of explosion of gunpowder.

5. Temperature, pressure, and work of explosion of gunpowder.  
Week ending September 1, 1876.

**Chemistry :**

1. Metallurgy of iron concluded ; cast irons ; soft irons from the ore ; steel, Bessemer process.

**Explosives :**

1. Use of fulminating mercury.
2. Fulminating mercury.
3. Schultze's powder.
4. Fuse-mixtures.
5. Chloride, bromide, and iodide of nitrogen.
6. Explosives in torpedoes.

In addition, the officers under instructions are familiarized with the making of nitro-glycerine, dynamite, fulminating mercury, and other explosives, and the modes of using them by experiment and practice with them.

**MISCELLANEOUS WORK.**

Besides the varieties of work which have been outlined in the foregoing pages, much other work has to be done in the laboratory of a station like this. In the laboratory are prepared battery-solutions, reagents, and other chemicals, fuse-compositions, &c., as they are required, firing-bolts, &c. Analytical work of various kinds has been performed, such as analysis of signal-fuse and firing-bolt compositions, clays, natural waters, mixed acids, wrought irons, and testing white-lead, glycerine, and other articles used at the station. Full records are kept of all the work and experiments which have been performed, so that reference to any part can be easily obtained.

To a very large extent, the work which has been performed to the present time has been preparatory. Everything had to be done from the beginning ; laboratories built and supplied with needed apparatus and facilities, and to do this has required much labor and patience. Much routine work has always had to be done. Consequently, experimental work has been greatly hampered and hindered. It may be said, however, that the preparations for useful work are now better than they ever have been, and very much is planned and now going on.

Very respectfully,

WALTER N. HILL,  
*Chemist.*

Capt. K. R. BREESE, U. S. N.,  
*In charge of Torpedo Station.*

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NAVY DEPARTMENT,  
BUREAU OF NAVIGATION AND OFFICE OF DETAIL,  
Washington, May 8, 1876.

SIR: In obedience to your order of April 20, 1876, a copy of which marked "A," is herewith appended, we have witnessed several tests of the Lay torpedo-boat. These trials have all been conducted to the satisfaction of the inventor, Mr. John L. Lay, and ourselves also, in accordance with the above order and the directions accompanying it, as follows: A letter addressed by Mr. Lay to the honorable Secretary of the Navy, and an indorsement thereon by the latter, a copy of which,



marked "B," is herewith appended, and an extract from the purchase contract between Mr. Lay and the Navy Department, a copy of which, marked "C," is hereunto appended; and we have the honor to make the following report:

A detailed account of the several trials that we have witnessed, marked "D," is appended to this report.

We are unanimously of the opinion that the Lay torpedo-boat is a valuable implement of warfare, and that in time of war it would be a formidable auxiliary to the naval service. We also recognize the necessity of officers being sufficiently familiar with it to prepare it for service and manipulate it. We believe it to be the most valuable movable torpedo of which we have any knowledge. Its range, one and a half ( $1\frac{1}{2}$ ) miles, and its ability to be started, stopped, and steered with perfect ease by an operator stationed at any fixed point, seem to render little else in this direction desirable. Probably this torpedo-boat would rarely be used at a distance exceeding one-half ( $\frac{1}{2}$ ) or three-fourths ( $\frac{3}{4}$ ) of a mile, but we consider a farther range than this desirable, in order that the boat may be maneuvered or sent against a second target if the first should be missed. We are of the opinion, however, that this torpedo-boat can be improved in point of speed and in some other details.

We have also to report that this torpedo-boat did not fulfill that part of the purchase contract which requires it to run a distance of one and a half ( $1\frac{1}{2}$ ) miles at the rate of nine (9) miles per hour. Upon reference to the detailed account of the trials, it will be seen that the distance of one and a half ( $1\frac{1}{2}$ ) miles was made at the rate of six and seventy-eight hundredths ( $6\frac{78}{100}$ ) miles per hour. The conditions that the boat should run one and a half miles, and be started, stopped, and guided at the will of an operator, were fully complied with.

We have the honor to be, sir, very respectfully, your obedient servants,

DANIEL AMMEN,  
Commodore, U. S. Navy.  
C. H. BALDWIN,  
Captain, U. S. Navy.  
J. L. DAVIS,  
Captain, U. S. Navy.  
MONTG. SICARD,  
Commander, U. S. Navy.  
FRED. RODGERS,  
Commander, U. S. Navy.  
R. B. BRADFORD,  
Lieutenant, U. S. Navy.

Hon. GEO. M. ROBESON,  
Secretary of the Navy.

[Indorsement by the Chief of Bureau of Ordnance.]

The chief of bureau cannot agree with this report, and is of opinion that the Lay torpedo is now what the Gatling gun was in 1861, a weapon of possibilities but of no practical utility. The board saw a success, I am cognizant of many failures.

Its present defects are, too great size; length of time required for its preparation; if carbonic acid gas is used, the necessity of a complicated apparatus and materials not always to be obtained for its generation; and great want of speed.

Lay is now under contract to deliver a boat which would make 9

statute miles; but he has not yet succeeded in going quite 7. I demanded 12 knots as the least speed likely to be effective in warfare, but conceded this point to the urgency of Mr. Lay. I am quite sure that with the same torpedo-boat in our hands we can make it go 9 knots: but this is a very moderate speed.

There is yet to be devised for it some safe and commodious method of carrying it inboard and launching it through a port, or safely securing it outboard for carriage at sea.

I am, therefore, of the opinion that as a practical implement of warfare it is valueless until greatly improved.

A.

NAVY DEPARTMENT,  
Washington, April 20, 1876.

SIR: A board, of which you are hereby appointed senior member, to consist of yourself, Captains Baldwin and Davis, Commanders Sicard and Rodgers, and Lient. R. B. Bradford, will assemble at the Washington navy-yard on Saturday, April 22, at 9.30 a. m., to witness and report upon such trials and tests of the Lay torpedo-boat now at that yard as will enable you to form a judgment upon its efficiency as an implement of warfare, and its probable utility to the naval service, and also as to whether it complies with the requirements of the accompanying extract from the contract with Mr. Lay under which it was built.

Lieutenant Bradford may manipulate the boat if Mr. Lay so desires, or any other person under his direction. You will also have such maneuvers performed as may be necessary to enable you to form a clear conception of its practical value.

You will therefore have careful notes taken of distances, time of starting and stopping, spaces passed over, and every circumstance favorable or unfavorable to the machine.

Respectfully, &c.,

GEO. M. ROBESON,  
*Secretary of the Navy.*

Commodore F. A. PARKER,  
*Chief Signal-Officer, Annapolis, Md.*  
(Commodore Ammen afterward substituted.)

B.

WASHINGTON, D. C., April 20, 1876.

SIR: I have learned incidentally the nature of the orders issued from the Navy Department that are to govern the trial of my torpedo-boat at the Washington navy-yard on Saturday, the 22d instant.

I feel constrained, in justice to myself and to the expected performance of the boat, if the trial is to take place at the time designated, to request that the order be modified by supplementary instructions to the official board to the following effect:

1st. That the board be directed to allow me to designate the point from which the boat shall be launched and started.

2d. That the course over which the boat shall be run shall be fixed under the direction of myself and those who assist me in manipulating its movements.

3d. That the official board be instructed, in any report they may make in reference to the distances made and speed attained by the boat, to take note of the fact that I have a formal standing proposition before the Navy Department for the modification or substitution of the engine now in use, stipulating that the boat shall, with such modification or substitution, attain the speed named in the specifications of my contract with the Navy Department.

These modifications of the order which I now request seem to me to be just and necessary to a fair trial of the boat at the time and place designated. I therefore respectfully urge a compliance with the request herein contained.

JOHN L. LAY.

Hon. GEO. M. ROBESON,  
*Secretary of the Navy.*

[Indorsement.]

I think, that to save all difficulty and question as to the invention, and to leave the inventor no cause of complaint in any event, the first and second of his requests should be complied with, and that he should be *first* allowed to start from any point he thinks most advantageous, and take such course as he may desire, and execute such move-

ments, to show the quality of his boat, as he may think fit; and that he should then be also required to move his boat along the course and in the manner desired by the board, and the board commandant of the Washington navy-yard will take action accordingly.

GEO. M. ROBESON,  
*Secretary of the Navy.*

C.

That for the consideration hereafter mentioned, he will furnish to the Navy Department one of his improved torpedo-boats and conduct such experiment with it at the torpedo-station, Newport, R. I., as may be necessary, upon the following conditions: It shall be started, stopped, and guided in any direction at the will of the operator. It shall be run a distance of one and a half ( $1\frac{1}{2}$ ) miles in a straight line at a speed of nine (9) miles an hour, or it may run a distance of seven-eighths ( $\frac{7}{8}$ ) of a mile and be brought back to the starting-point. It shall chase and strike a vessel of not less than one hundred and thirty feet in length, moving within a radius of not over three-fourths ( $\frac{3}{4}$ ) of a mile from the operator at a speed not exceeding five (5) miles per hour, the Government furnishing such men and vessel as may be necessary to make the trial.

D.

*Record of the trial of a torpedo-boat, exhibited by John L. Lay, before a naval board, convened by an order of the honorable Secretary of the Navy, dated April 20, 1876.*

As Mr. Lay's contract with the Navy Department required his torpedo-boat to make a trial of speed, one statute mile (divided into quarters) was laid off, from the navy-yard water-front across the shoal water of the Anacostia toward Buzzard Point. This route was selected by Mr. Lay as most convenient to himself.

UNITED STATES NAVY-YARD,  
*Washington, April 22, 1876.*

The board above referred to met at 10.30 a. m., and consisted of Commodore Daniel Ammen, Capt. Charles H. Baldwin, Capt. John L. Davis, Commander Montgomery Sicard, Commodore Frederick Rodgers, and Lieut. E. B. Bradford.

Mr. Lay appeared before the board and stated that he could not run the torpedo-boat along the course selected by him, as he feared that there would not be water enough to float her properly. He, however, requested permission to show the turning and working qualities of his boat by maneuvering her in the channel of the Anacostia, directly off the navy-yard. This the board assented to, and proceeded to the fore-castle of the United States steamship Wyoming, from whence a good view of the maneuvers could be obtained.

The torpedo-boat was steered by Lieut. E. B. Bradford, (at Mr. Lay's request,) and ran up and down the channel several times, and on various courses; obeyed her helm quickly; could be directed with certainty on any given course; turned  $180^\circ$  four times, and, in short, maneuvered well—the board being satisfied that she could be readily and conveniently controlled. A small torpedo, containing about a pound of powder, was exploded from her bow at the will of the operator. While running, the boat heeled to port some  $5^\circ$ .

It being evident that there would probably be difficulty in making the speed-trial of the torpedo-boat across the Anacostia flats, (on account of the shoalness of the water,) the board directed a statute mile (divided into quarters) to be laid off from Giesboro' Point, on the Potomac River, toward Bellevue magazine.

On this line the marking-stakes were so planted that the torpedo-boat could be run parallel to them in deep water.

APRIL 24.

Mr. Lay had the torpedo-boat opened, and her mechanism and its mode of action were explained to the board.

APRIL 27.

The board met at 10.45 a. m., and proceeded in the United States tug Rescue to the measured course off Giesboro' Point. The torpedo-boat had been previously towed down to the same point by a steam-launch.

On conference with his assistants, Mr. Lay stated that the torpedo-boat could not run in her then condition, some internal derangement (which was not explained at the time) having taken place.

The boat appeared to settle deeper in the water than usual.

Mr. Lay seemed desirous to run, and at his suggestion an attempt was made to hoist the boat (at the Rescue's davits) for the purpose of getting at her bottom, and, if possible, putting her in condition to make the run.

The davits proved too weak to raise the boat, so it was concluded to give up the trial for that day, and all returned to the navy-yard.

After an examination had been made of the interior of the torpedo-boat by Mr. Lay's assistants, the reason why she settled deeper than usual was understood to be as follows: One end of the cable passes (by means of a stuffing-box) from the compartment containing the cable to that containing the engines. This stuffing-box had not been set up properly, and the air, which usually occupies a considerable part of the space around the cable, had been driven by the water-pressure through the loosened stuffing-box into the engine-compartment. The space thus vacated being full of water, the boat lost a portion of her buoyancy.

APRIL 28.

The board met at 10.30 a. m., and received a communication from Mr. Lay, expressing his desire to run on the measured course as laid off from the navy-yard toward Buzzard Point.

The tide was unusually high, and the board assented to the arrangement. The distance being three quarters of a mile and return—with the wind (and a slight sea or wash) about two points on the boat's port bow—running down.

Previous to the trial it was proposed that one of Mr. Lay's assistants should be stationed at the end of the outward course, to turn the boat by hand, and place her in position for the return run. The object of this was to save cable and gas expenditure.

The board, having on a previous occasion witnessed the maneuvering of the boat, did not require any further experiments in that direction, and consequently assented to the arrangement.

The speed trial commenced at 10.52 a. m., the board being stationed on the United States steamer Alarm, at the commencement of the measured distance. Commander Sicard coursed the torpedo, and Lieutenant Bradford steered and managed her through the key-board.

The run down the course (against wind and sea) was very creditably made. The boat showed a tendency to go to port, requiring the port helm frequently, but she obeyed quickly, and was perfectly under command. She heeled about five degrees to port.

After passing the stake that marks three-fourths of a mile, the boat was stopped by Lieutenant Bradford, and, being turned by Mr. Lay's man, commenced her return. After running about one hundred yards she did not appear to answer to her helm, and it was immediately found that she had stopped.

She was towed to the navy-yard, when it was found that the cable had fouled around the propeller, being jammed with many turns around the screw-shaft between the hub of the propeller and the end of the sleeve through the boat's stern; the cable was also parted.

The following intervals of time were consumed by the torpedo-boat in passing between the quarter-mile stakes on this occasion:

	m. s.
First quarter mile .....	2. 12
Second quarter mile .....	3. 18
Third quarter mile .....	2. 19
Made the three-quarters .....	6. 49

This is at the rate of 6.60 (six and six-tenths) statute miles per hour.

MAY 3.

The torpedo-boat being ready for another speed trial, the board met at 1.30 p. m., and proceeded from the navy-yard in the United States tug Rescue, toward the measured course of Giesboro' Point. The Rescue's davits had been shored up, and the torpedo-boat was hoisted by them, she hanging just clear of the water.

While running down toward Giesboro', Mr. Lay informed the board that he had only cable enough in his torpedo-boat to allow her to run one and a half miles. He also stated that the cable in the boat was heavier than that which had been used on the occasion of the former trial.

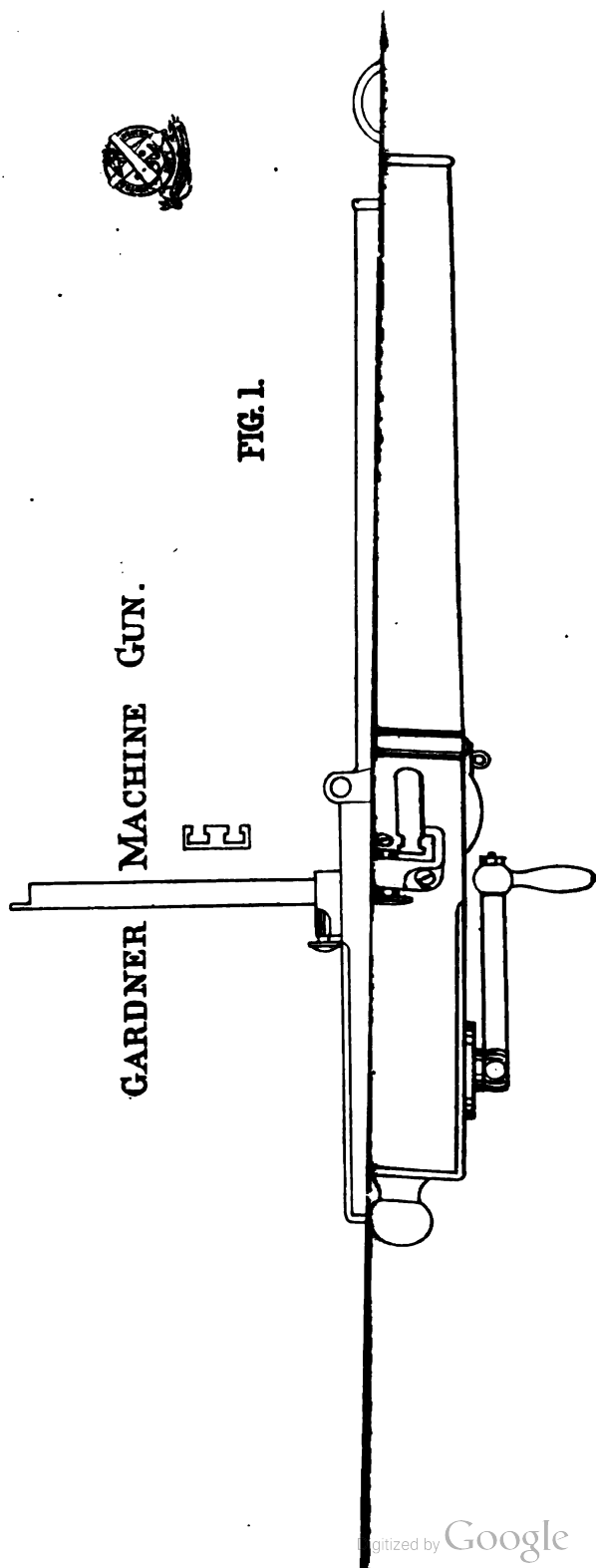
Arrived at Giesboro', the steering signal was planted and the Rescue anchored just above the northernmost end of the measured course.

The torpedo-boat was lowered and prepared, and started upon her speed-trial; the tide running ebb about one-quarter knot per hour.

The boat was coursed by Commander Sicard, and steered and managed by Lieutenant Bradford, at Mr. Lay's request. She ran about one hundred yards and stopped; examination disclosed the fact that her cable was broken; having been fouled by the propeller. Many jamming turns were taken around the screw-shaft, between the propeller hub and stern of the boat.

She was brought back to the Rescue and hoisted clear of the water; the fouled cable was cut away; and the remainder, or good part of the cable, was properly connected and tested.





The boat then started upon her speed-trial, and ran down the measured course, (three-fourths of a mile,) steering very well indeed. On passing the three-quarter stake she was stopped; and after being turned by Mr. Lay's assistants, started on her return run.

After moving about one hundred yards she stopped; and examination showed that the cable was again fouled around the propeller; many turns were taken tightly about the hub and stern of the boat, and the cable was parted as before. The trial being concluded for the day, the torpedo, &c., returned to the navy-yard.

The following intervals of time were consumed by the torpedo-boat in passing between the stakes:

	m. s.
First quarter mile in .....	2. 16
Second quarter mile in .....	2. 09
Third quarter mile in .....	2. 14

The three-quarters made in ..... 6. 39

This three-quarters of a mile was made at the rate of 6.77 (six and seventy-seven hundredths) statute miles per hour, including a slight current in favor of the boat. There was no wind.

#### MAY 6.

The torpedo-boat being reported ready for another trial, the board assembled at 11 a. m., and proceeded from the navy-yard in United States tug Rescue to the course off Giesboro. Mr. Lay stated to the board that the boat's cable was not sufficiently long to admit of a run of over one and one-half miles.

By his request Commander Sicard coursed and Lieutenant Bradford steered and managed the boat. The tide was running ebb at the rate of one-quarter knot per hour.

On this occasion a run of one and one-half miles was successfully accomplished, the cable being apparently exhausted just as the boat completed the distance. At the three-quarter mile stake she was turned by hand as usual. She started on this trial very well, indeed, answering her helm quickly, and was perfectly under command. As usual she required the port-helm frequently, and heeled to port about five degrees. The fact of her requiring the port-helm frequently is not a point of very special importance in her management, though, of course, she would be more perfect if it was corrected.

The following intervals of time were consumed in passing the stakes on this occasion. There was no wind:

#### *Running down.*

	m. s.
First quarter mile .....	1. 50
Second quarter mile .....	1. 54
Third quarter mile .....	2. 09

#### *Returning.*

First quarter mile .....	2. 28
Second quarter mile .....	2. 33
Third quarter mile .....	2. 26

Total ..... 13. 16

The boat accomplished the run down at the rate per hour of 7.36 statute miles.

The run back was accomplished at the rate per hour of 6.18 statute miles.

The whole run (one and one-half miles) was accomplished at the mean rate per hour of 6.78 statute miles.

In the second and third trials the principal difficulty was a very simple one and apparently easily remedied, as the fouling of the propeller by the cable was obviated in the last trial by a simple extension of the cable hawse-pipe to a point just abaft the propeller.

ORDNANCE OFFICE, NAVY-YARD,  
Washington, D. C., December 14, 1875.

SIR: I beg leave to submit the following report on the "Gardner gun," which has been subjected to trial at this department agreeably to your endorsement on the bureau's order of November 30, 1875.

The gun referred to is very simple in construction, consisting of a strong steel frame, in which are inserted two rifle-barrels, the chambers of which are fed by two simple and strong steel locks, which receive their motion from a double cam operated by a hand-crank. Each lock is furnished with a simple strong steel hammer actuated by a stout main-

spring. The locks and cam are inclosed in a bronze box which occupies the rear end of the machine.

Cartridges are fed to the gun through the upper side of the bronze box, and drop from the feed-case into a lodgment in rear of the barrels. The rate of feed is controlled by a couple of levers, (just under the feed-ports) gearing with the forward ends of the lock-plungers by a simple series of studs and bevel edges, in such a way as to open the feed when a plunger is withdrawn, (thereby allowing a single cartridge to descend,) and closing it off as the plunger advances to push this cartridge into the barrel. This arrangement is intended to prevent the crowding of cartridges toward the chambers, which in machine-guns sometimes leads to jamming of the mechanism.

The feed-case is a simple rectangular box, of thin wood, with tin partitions dividing it vertically into four passages; it is fitted with a sliding tin bottom and holds forty cartridges in four columns, one column having access to each of the two feed-ports at the same time; the two other columns being stopped off by the tin bottom. When the first two columns are exhausted, a lateral movement of the case brings the remaining two columns over the feed-ports, and opposite the holes in the tin bottom.

The feed-case is about eight inches high. Alternate columns of cartridges feed at the same time.

This gun fires Burdan cartridges, caliber 42.

The feed-ports are not correctly placed as regards the rear of the barrels. This being the first gun manufactured, the ports (by a mechanical error) were not so situated as to give a vertical drop to the cartridge from the feed-case into the mechanism. This perhaps places the piece somewhat at a disadvantage as regards smoothness of feed.

The trunnions of the gun rest in a saddle which is connected with a tripod in the ordinary way, giving motion in horizontal and vertical planes. There is no traversing arrangement attached; and I learn that none is yet designed.

On the morning of December 2, the gun was set up in the ordnance finishing-shop and its mechanism explained. It was then easily carried to the experimental battery by one man, (another carrying the tripod.) After being set up near the edge of the water, and depressed about fifteen degrees, the piece was fired 1,200 rounds.

While delivering this fire the gun stopped five times; the stoppages lasting from six to thirty seconds, and being in each case due to imperfection in the feed-arrangements. In order to clear the mechanism it was usually necessary to throw back the cover from the locks, when the whole internal mechanism is easily seen, and the cartridges in the guides can be taken out by hand very readily.

Besides the stoppages above enumerated, there occurred one more serious, (lasting two minutes fifteen seconds,) which was due to the intrusion of a piece of lead from the bullet into the extractor recess cut in the upper part of the rear face of the left barrel. This lead prevented the hook of the extractor from entering its recess to take hold of the butt of a cartridge-shell ready to be withdrawn.

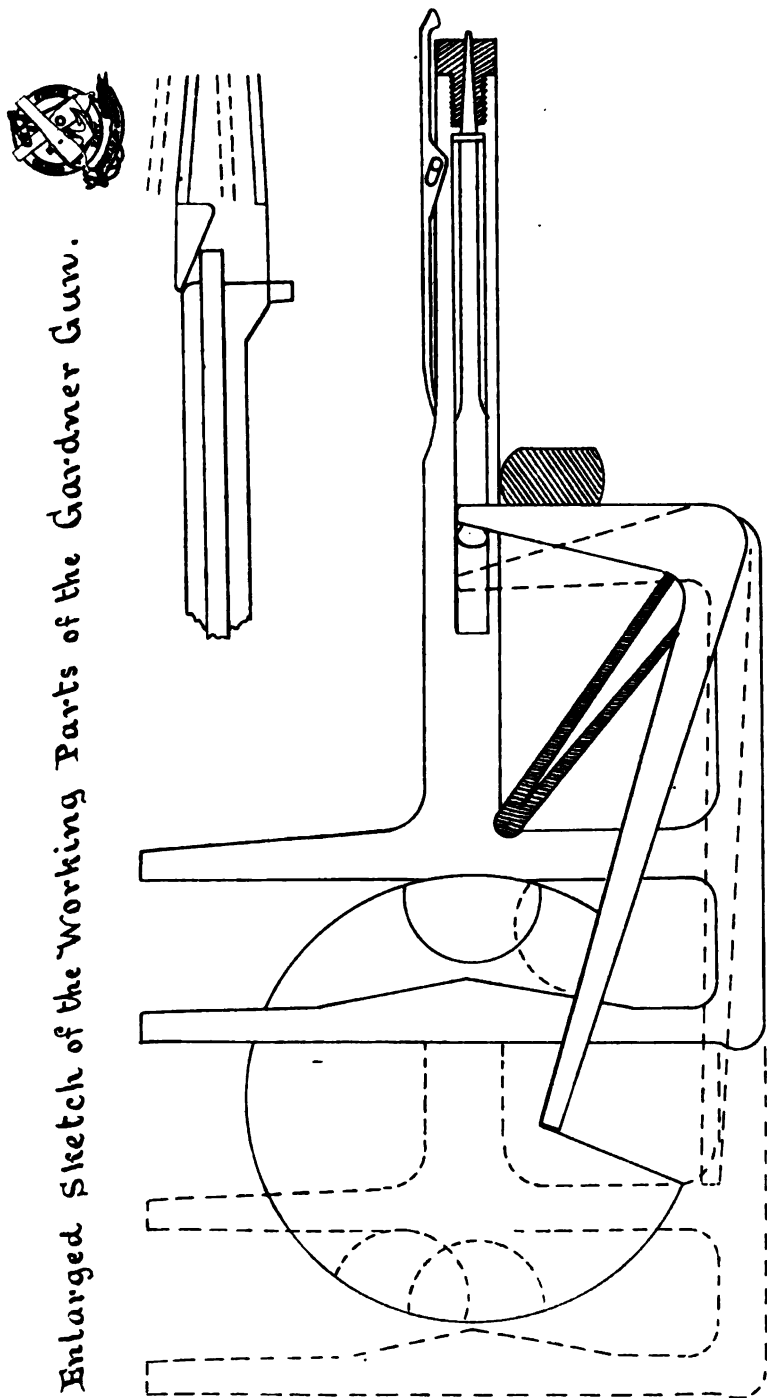
The lead was removed from the extractor recess by the point of a knife-blade, the mechanism (as before remarked) being wholly exposed on raising the cover.

The firing ceased, for the morning, at 1,200 rounds, the gun having averaged 111.4 shots per minute, (including stoppages.)

In one minute 153 shots were fired, and in three minutes 400 shots: this included several of the above-mentioned stoppages.



Enlarged Sketch of the Working Parts of the Gardner Gun.





Toward the close of this practice, the barrels became greatly heated, passing to a blue color; paper ignited readily when placed between them. The heat did not affect the working of the piece and did not extend to the breech-mechanism.

On the afternoon of December 2, 1,920 rounds were fired. Cartridges jammed in feeding fifteen times, causing stoppages ranging in duration from ten to thirty-six seconds each. Besides the above, one shell failed to extract, causing a stoppage of one minute, and a lock was shifted twice, causing stoppages amounting to three minutes thirty-seven seconds. The locks were also oiled, with a stoppage of fifty-four seconds.

The barrels a great deal of the time were at a blue heat and ignited paper readily. The working of the gun was not affected.

The shifting of the lock the first time was not strictly necessary, but was done at the desire of Mr. Gardner. The new lock not having been oiled, soon worked a little stiff, and showed some slight wear at the points where the bearing faces come in contact with the cam. Subsequently the first lock was replaced after having been lubricated with tallow. It worked admirably during the rest of the trial. I am informed by Mr. Gardner that these locks and the cam are made of soft steel.

This afternoon the gun averaged 73 shots per minute, including stoppages; the latter averaging in the aggregate to 12' 13" in the space of 26' 20". The piece was not, however, running on speed.

Six cartridges were recovered, from under the gun, struck by the firing-pin but not exploded; a few of these on being passed through a second time were discharged.

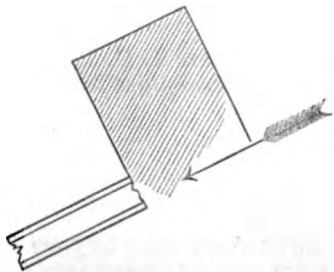
Twelve cartridges were picked up which had not been in the barrels of the piece; these were probably dropped during the various stoppages while the feed was being cleared.

The fifteen stoppages due to jamming of cartridges in feeding were all caused by the cartridges entering the breech-mechanism bullet down.

The intention of the inventor was to have had these cartridges drop into the mechanism with their axes approximately parallel to that of their barrel. This object was defeated partly by the nature of the cartridge, (the Berdan, which has a bullet of less diameter than that of the powder-charge,) partly by the manner of stowing these cartridges in the feed cases, (the upper ones naturally inclining bullet downward,) and partly to the fact that the gun was fired at considerable depression, which naturally caused the points of the cartridges to crowd toward the forward lower part of the feed-case. Their axis showing thus:

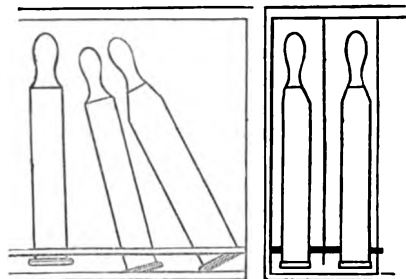
As the cartridge is released from the feed and is met by the advancing plunger the position of its axis is unfavorable to proper loading, and the result is frequently a jam, as shown in the sketch.

Mr. Gardner concluded to make an alteration in some of his feed-cases, with the object of preventing the cartridges from working toward the forward side of the feed-case when the gun is fired at a depression. For this purpose he soldered four wires on the inner sides of each compartment in the feed-case in such a manner as to catch the flanges on the butts of the cartridges, thus holding them toward the rear of the case and allowing them to descend toward the



feed-ports without sliding forward. This arrangement was somewhat as shown in the annexed sketch.

On the afternoon of December 3, the gun was again fired at the water's edge. The gun was depressed about  $20^{\circ}$ , and 1,100 rounds fired.



The new arrangement of the feed-case was found to be an improvement, but did not entirely prevent the entry of the cartridges into the piece bullet first, and consequent occasional jamming. Eight hundred rounds were then fired with the gun about  $4^{\circ}$  elevation, but the feed did not show very material improvement, and at no time this afternoon could

more than 200 rounds be fired without a stoppage, which, however, only lasted from 10 to 20 seconds.

The same lock that gave trouble the previous day commenced to work stiffly during this last trial. It was taken out, rubbed with emery-paper, and replaced, (after being tallowed.)

It worked smoothly during the rest of the trial, at a rate of speed much exceeding 200 shots per minute. When running at speed, the empty cartridge-shells (after extraction from the barrel) are liable to be caught by the advancing plunger, before gravity has had time to draw them down clear of the mechanism. This fault could probably be obviated by increasing the throw of the cam, thus causing the locks to travel farther, and giving more time to the descending shell. It will be observed that most of the defects discussed in the foregoing report are due to the defective feed, and can, I think, be remedied without much difficulty. The wear on the locks and the limited throw of the cam are defects in the gun proper, and are also probably easily remedied.

I regard the performance of this gun as very remarkable, and its strength, lightness, and extreme simplicity as most admirable. It seems only to require a little improvement (mostly in the feed) to make it all that can be desired in a machine-gun.

It will, of course, be understood that in a piece which loads and extracts with such extreme rapidity, the cartridge-shells must be of the best quality, both as regards material and workmanship.

In extraction, particularly, there would be a great risk of tearing the butts entirely off a weak cartridge-shell, when the next round would stop the gun.

I am, sir, your obedient servant,

MONTG. SICARD,

*Commander, and Inspector of Ordnance.*

Commodore T. H. PATTERSON,

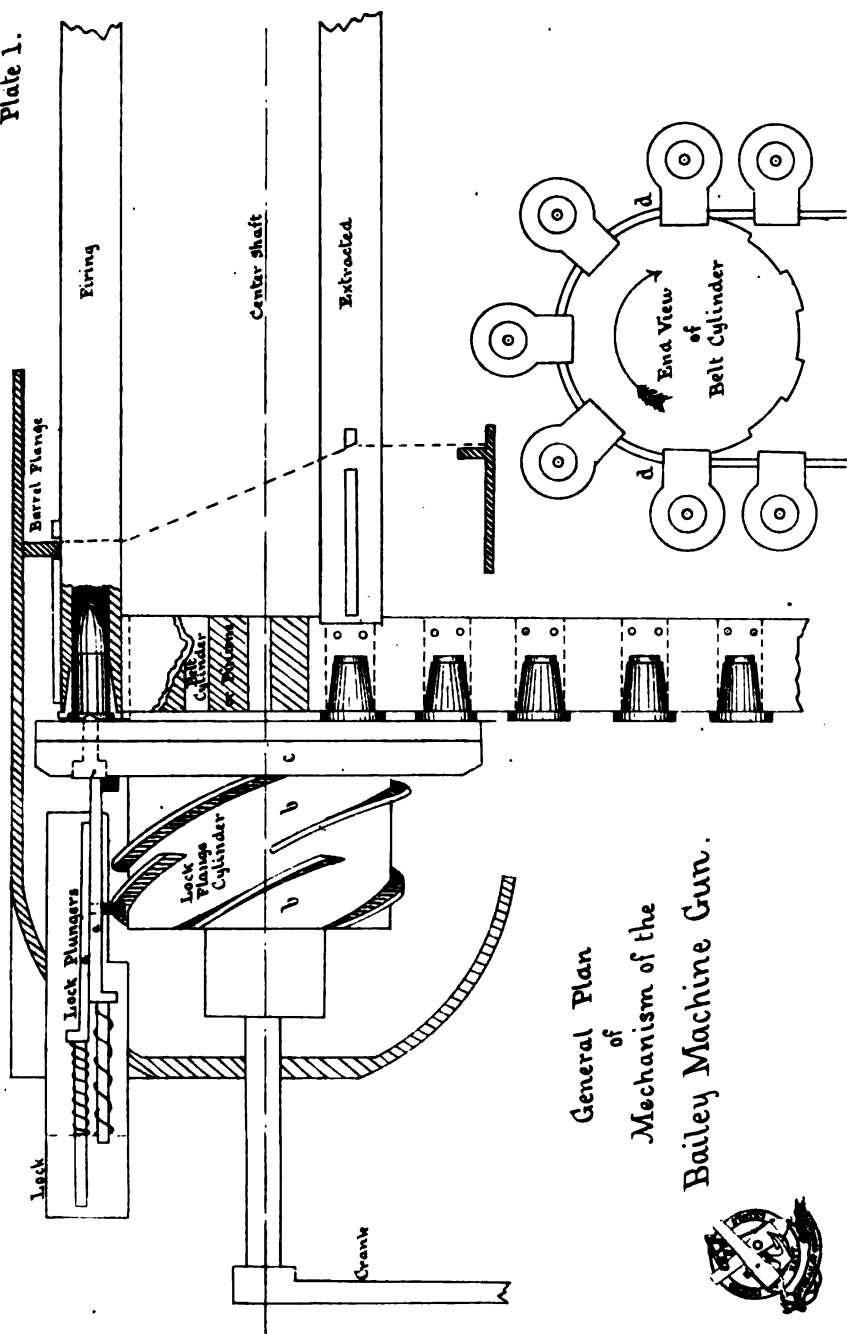
*Commandant Navy-Yard, Washington, D. C.*

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ORDNANCE OFFICE, NAVY-YARD,  
Washington, D. C., February 11, 1876.

SIR: Agreeably to your indorsement on an order from the Bureau of Ordnance, dated January 31, 1876, I beg leave to report as follows regarding an examination and trial of the Bailey machine-gun.

This piece was presented by its projector, Mr. F. L. Bailey, of Indianapolis, Ind. In general external appearance it somewhat resembles



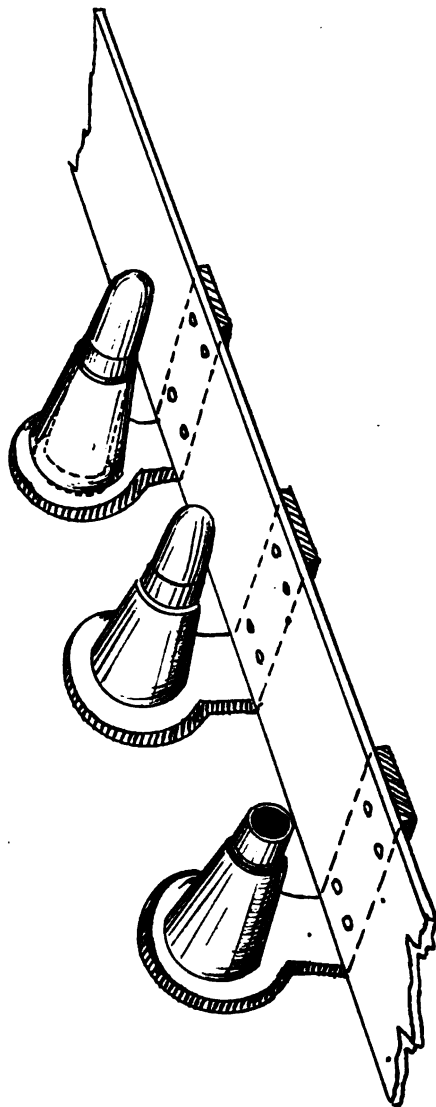
General Plan  
of  
Mechanism of the  
Bailey Machine Gun.







Plate 2.



Belt with Sockets & Cartridge.



the Gatling, having its barrels grouped around a central shaft, and steadied in circular disks toward each end, in the same manner as the well-known machine-gun referred to. It is, however, very different from the Gatling in its mechanism and mode of feeding and extraction.

The piece presented for examination is small in size, being only intended as a preliminary model for the purpose of showing the working of the system. The caliber is .32 inch.

The mechanism will be best understood by reference to the accompanying figures.

When the center-shaft (*a*) is turned, the barrels, while revolving around this axis, also move backward and forward in a longitudinal direction by virtue of their engagement with an inclined flange or cam; very much in the same way as a similar motion is communicated to the locks of a Gatling. The barrels have, of course, sufficient play in their bearings (*cc*) to admit of such motion, (and also of increase of diameter, due to heating,) and they are turned cylindrically for the length of their travel. In the figures, the upper barrel is not the firing-point, and the cartridge-shell is completely extracted from the one just below the line of the central shaft.

The plate turns with the system and carries the firing-pins near its periphery, one being opposite the rear of each barrel. Every alternate pin, as it arrives at the firing-point,  $\times$ , Fig. 1, is struck by one of two lock-plungers, secured into a single box, which is inserted into the breech-cover in rear of and in a prolongation of the axis of the barrel, which may be at the firing-point. This constitutes the only lock in the gun. A rough sketch of these lock-plungers is here given, and will sufficiently explain their mode of action. (Fig. 2.)

They consist of two flat pieces of steel, with shanks on the rear ends. These shanks serve as guides to the spiral springs which drive the plungers forward when the studs *a a* are alternately released from their contact with the flanges of the cam-cylinder *b b*, Fig. 5, (appended.)

The cam-cylinder is a simple and strong barrel, (Fig. 5, *b b*,) firmly secured to the center-shaft, just in rear of the diaphragm *c*. It carries on its surface two separate sets of "sections of screw-threads," having a quick pitch. Each set of threads (or cam-flanges) as brought around by the revolutions of the central shaft engage successively with the studs on its lock-plunger, each set of flanges always working its own plunger.

As the cam-cylinder travels around, the flange that is engaged with the stud of a lock-plunger forces it back, until (the end of the flange being reached) the stud is released, and, actuated by its spiral spring, the plunger is driven forward against the firing-pin.

The plungers are seen from the side in the figure, (5, *a a*,) and the manner in which they are alternately released and drawn back by the action of the flanges on the revolving cam-cylinder will be apparent.

As each plunger is being drawn back, (after striking,) the motion of the center-shaft brings around another barrel, and presents it with its firing-pin in position to be struck by the *other* plunger as soon as this latter is released.

The plan for feed of cartridges and extraction of shells is novel. Secured on the central shaft, just forward of the firing-pin plate, and inside of the circle formed by the rear ends of the barrels, is a cylinder of wrought iron, having its surface indented by recesses, the general direction of which is parallel to the axis of the center-shaft.

These indentations are intended to engage with flat pieces of brass of similar shape which are riveted to the under side of a leather belt, the

pitch being made the same as that of the indentations on the cylinder. It is evident that if the first of these flat pieces be engaged with an indentation on the cylinder and the center-shaft be turned from left to right, the belt will pass over the upper side of the cylinder in the same direction. (Fig. 5, *d*.) In short, the belt is a kind of flexible rack, running over and actuated by a pinion.

Forming one with the rear end of each tooth on the belt, and standing up at right angles to its surface, is a brass socket for the reception of metallic cartridges. (Figs. 4 and 5.) The pitch of the gearing thus far described is such that the distance between successive axes of the metallic cartridges (when placed in these sockets) will be just equal to that between the axes of successive barrels of the gun.

The sockets are conical on the exterior, and are bored through to receive the metallic cartridge, which is pushed in from the rear, the flange of the cartridge fitting into a recess cut into the rear face of the socket. A small portion of the cartridge-case and the whole of the bullet project beyond the forward end of the conical socket. (Figs. 4 and 5.) When the cartridges have been placed in the sockets, the former stand with their axes parallel to the upper surface of the belt, and perpendicular to the direction of its length, on the loading (or left) side of the gun. This places them in prolongation of the axes of the barrels and just to the rear of the latter.

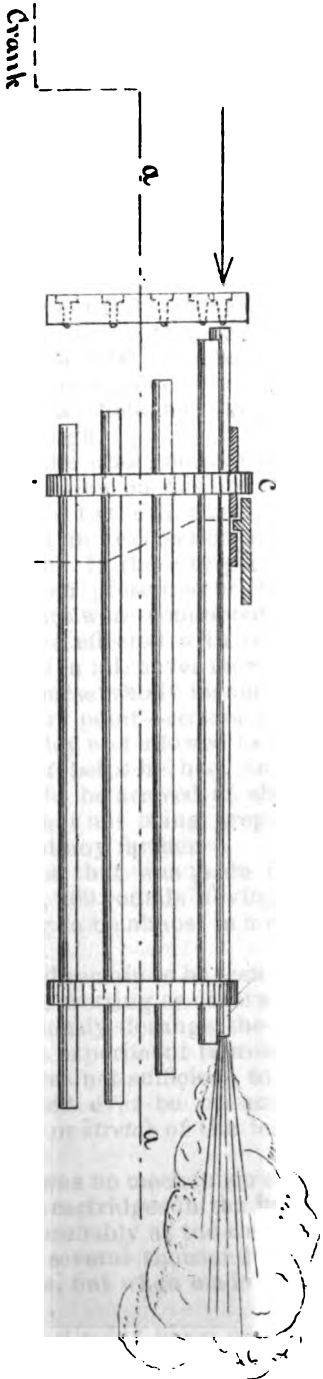
The rear ends of the gun-barrels are bored conically to fit neatly over the belt-sockets *e*, Fig. 5.

As the center-shaft is revolved, the belt, loaded with its cartridges, is drawn up and over the indented cylinder, a cartridge coming opposite the opening in the rear of each barrel in succession. The barrel-cam causes the barrels on the left or loading side of the piece to move to the rear, and as the gun revolves, each barrel in succession gradually covers its loaded socket. By the time any particular barrel has reached the highest position in the gun *e*, Fig. 5, it has received the corresponding socket and cartridge entirely within its breech, and the butt of the cartridge is backed up in rear by the firing-pin plate.

Everything being now in place and secure, one of the lock-plungers is released (by the lock-cam cylinder) and strikes the firing-pin, exploding the cartridge. This takes place, as before remarked, at the highest point that each barrel can reach in its revolution around the center-shaft. If the revolution of the center-shaft be continued the barrels will come successively to the firing-point, covering the sockets, and being struck by the alternate lock-plungers, as before described. So much for the loading and firing.

After the bullet has left the barrel, the latter is urged to the front by its cam, and, as the gun revolves, gradually uncovers the cartridge-socket, with the empty shell still remaining in it; when the socket is completely unmasked, (which occurs at a quarter revolution from the highest point, (Figs. 1 and 5), the belt no longer follows the surface of the indented cylinder, but runs vertically down toward the ground, laden with its empty cartridge-shells still remaining in their sockets. Thus extraction is completed as far as the gun is concerned, it still requiring to be completed as far the belt is concerned, either by hand or by extracting and reloading machinery, which latter was not shown.

A belt can be made of almost any convenient length, and the head of one can be readily hooked to the end of that already working through the gun, thus keeping up the fire, I should think, without difficulty. The experiments in this direction were limited, as the exhibitor had but a few short belts, none holding over one hundred rounds.



Motion of the Barrels.



The belt is readily introduced into the gun on the left side, and the whole feeding and firing mechanism is concealed by bronze hinged covers when on ordinary service. By throwing these back, however, all the working parts become at once plainly presented to view. The crank cannot be turned backward while the breech-covers are down.

This gun is much more simple than the Gatling, having fewer parts, but it is not as simple as the Gardner gun, though it would seem not much more likely to get out of order than the latter. In this last respect both are superior to the Gatling.

The principal advantage of the Bailey over the Gatling gun consists in the simplicity of the lock mechanism. It does not seem probable that any amount of firing would injure the lock, and even if it were to break, it is but the work of a moment to insert another one.

The locks of the Gardner are simpler than those of the Bailey gun.

I do not think the play allowed the barrels in their disks would seriously affect the accuracy of fire, as far as the demands of ordinary service are concerned; but such an arrangement of course results in a system, as a whole, not quite as rigid as that of Gatling, but still quite strong enough.

Nearly the whole mechanism of both the Gardner and the Bailey is exposed to view on raising the breech-covers, and in this respect they are superior to the Gatling.

The feed and extraction are, however, the leading peculiarities of the Bailey gun. In these respects it is wholly different from any piece that has yet been presented at the Department for trial; and as far as the experiments were conducted here, both of the operations referred to seem to be effected with certainty. But the number of rounds fired (about 300 in all, never more than 100 at a time, and usually only 25) was of course wholly insufficient to base any decision upon regarding the primary point—*certainty of action*.

Mr. Bailey was allowed to fire as much as he desired, with the limited amount of belts he had, and I explained to him that no decision of value could be arrived at short of the expenditure of many thousand rounds; but not being prepared for extended firing, he did not desire to proceed any farther.

The test that was made for *rapidity* of fire was, however, truly astonishing, 100 rounds having been fired in about six seconds, the gun appearing to be almost in a continual blaze. The whole number ran off smoothly.

It would remain to be seen whether when using these belts any shrinkage (from wetting or otherwise) would so alter the "pitch" on the belt as to seriously derange the feed. The inventor told me that he had tried that experiment thoroughly, and had found that the shrinkage of leather was not sufficient to affect the smoothness of the feed. If the gun should ever be presented for regular test, this point, regarding *shrinkage* or *stretch* of the leather belt, would require to be thoroughly tested.

There was no mechanism shown for removing empty shells and inserting fresh cartridges in the belts. This operation of course must be performed, probably at the caisson, though there would be no difficulty in carrying several thousand rounds in belts. The belts look somewhat expensive, but when made by machinery could be produced cheaply no doubt.

The particular piece under examination was not manufactured by a regular gun-maker, and consequently did not work smoothly in all its parts; but that imperfection is of course easily remedied. As regards

simplicity of mechanism, this gun stands between the Gatling and the Gardner; and if the feed should prove to be certain in its action, (and I have no evidence that it will not,) the gun would hold that position in all respects.

I am, sir, your obedient servant,

MONTG. SICARD,

*Commander, and Inspector of Ordnance.*

Commodore T. H. PATTERSON,

*Commandant.*

#### NAVAL EXPERIMENTAL BATTERY.

*Annapolis, Md., October 3, 1876.*

SIR: In obedience to orders of the Bureau of Ordnance, dated September 30, 1876, convening a board to witness the trial of the Lowell battery gun, the board met at this place at 10 a. m., October 3, 1876. In addition to the board there were present, Col. J. G. Benton, Army Ordnance; Captain W. N. Jeffers, Chief of Bureau Navy Ordnance, and Lieut.-Commander F. Pearson, United States Navy, also several officers from the Naval Academy.

The gun was first inspected, its working-parts and mechanism being fully explained by Mr. Farrington, its inventor.

In view of the elaborate report on this gun, made by Commander Sicard in February last, we do not think it necessary to describe all its details, except where we find essential changes have been made.

There have been two new features introduced since last reported on; these are, first, the method of feeding the cartridges, and second, a new lock, firing by direct *pressure*, instead of *striking* the base of the cartridge, as in the usual method.

We will proceed to describe these features in detail. The "feeder" (see Fig. 1) consists of a nearly square iron tube, firmly set in a socket directly over the "carrier-rolls." It stands upright, and can be removed if necessary by loosening a set-screw at its lower end. This tube or feeder is sufficiently high to hold thirty cartridges, the number contained in two of the paper cases, hereafter described. It has a slot in its forward side extending its whole length, of a width slightly greater than the diameter of the cartridge. It also has on its interior, and opposite each other, two narrow longitudinal grooves of a width and length slightly greater than the flange of the base of the cartridge. This tube is open, and slightly trumpet-shaped at its top to facilitate the introduction of the cartridge. If one or more cartridges be introduced into the "feeder," with the flange of the cartridge entered into the parallel grooves, it will of its own accord drop to the bottom, preserving its original horizontal position through its whole descent, passing out of the feed-case at its bottom and entering the "carrier-rolls" in the proper position to be entered into the barrel with the advancing lock-plunger. Fig. 1 shows roughly this feed-case with a cartridge at the bottom. In the socket which holds the feeder is a "stop," (A, Fig. 1) with a milled head, normally held back by a spiral spring, that allows the cartridge to fall. Whenever the operator wishes to cut off the feed, he pushes in this "stop," turning it slightly to the left, it being held in that position by a small pin (B) entering a slot.

The cartridges were supplied in paper cases, each case containing fifteen cartridges. Figures 2 and 3 show the cases, empty and filled. The case is made to hold the cartridges in a single row, each cartridge hav-

FIG. 1.

Feeder.

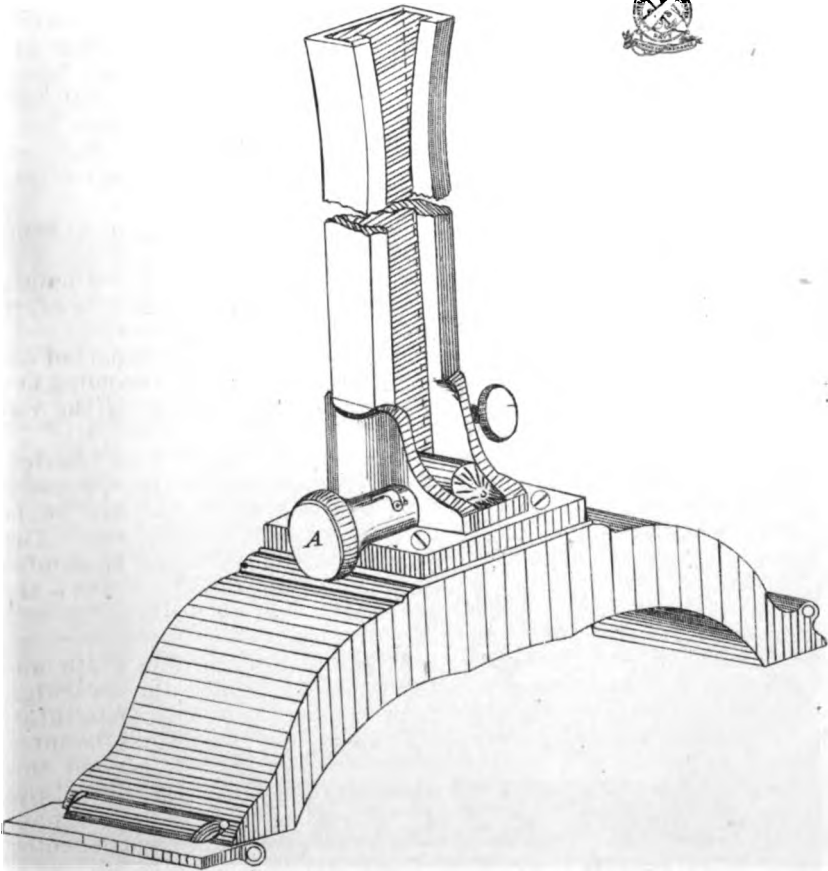








FIG. 2.



Cartridge Case, full.

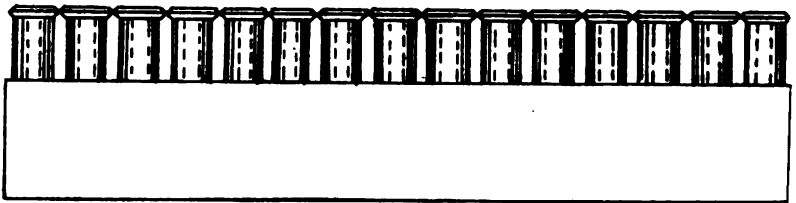


FIG. 3.

Empty.



ing a compartment to itself; the bullet and about one third the shell being entered in the paper case, so that the latter, when filled with cartridges, holds them firmly with their bases and flanges in the same plane; the whole fifteen cartridges being readily entered into the "feeder"; this being done, the cartridges being held by the flanges entering the two parallel grooves, already mentioned, the paper case is pulled away, leaving the cartridges free to descend to the "carrier-rolls."

As the paper cases are prepared and filled with cartridges at the factory, the ammunition goes to the gun ready for use without any other preparation, doing away with the operation of filling feed-cases previous to using the gun; and, in fact, doing away with the shifting feed-case altogether. The paper case is also a neat and secure way of packing the cartridges for general transportation, and being inexpensive, is thrown away as soon as the cartridges it contained are placed in the permanent feed-case or "feeder."

The pressure-lock is shown in figure 4, and was used during a portion of the trial.

The firing by pressure is based on the fact that, in manufacturing the cartridges, a certain amount of pressure is always applied to the fulminate sufficient to explode about one in twenty. This is done to make the cartridges sufficiently delicate (consistent with safety) to insure explosion. If this pressure should be increased to a known point, instead of one in twenty exploding, they would all do so. This is, in reality, what is done by the pressure-lock, the firing-pin exerting a *pressure*, instead of *striking a blow*, doing away with the necessity of the usual spiral spring. The one used in this trial did not operate with as much certainty as the percussion-lock; but it being an "after-thought," as regards this gun, some of its parts, particularly the lug which receives the pressure from the cam, are not as strong as they otherwise would be. Five hundred and fifty rounds were fired with it, fifteen of which failed. The small spiral spring on the firing-pin is to keep it always back, clear of the face of the lock-plunger. While using the pressure-lock, this spiral spring was removed; the cartridge itself pushing back the firing-pin, as it was carried down by the rolls. This was done at the suggestion of Mr. Farrington, who stated that the spring was not at all necessary, and that the firing-pin could easily be arranged to withdraw to the rear by a positive motion.

The double extractor used in this gun, (C, Fig. 4,) locked by a positive movement of the shoulder on the plunger A, Fig. 4, not depending on its own stiffness or spring, is a very valuable feature; in fact, next to the feed, we may say its *most* valuable feature. For after all, what is a machine-gun but feeding, firing, and extracting? These three operations, working as they do in this gun with an almost absolute certainty, leave little to be desired. The cartridge being grasped on both sides by the double-extractors, slightly above its horizontal diameter, allows it to be readily removed from them by the "carrier-rolls," which *positively* carry the empty shell down—it not depending at all upon gravity until it is clear of the gun.

The following is a record of the firing:

	Time.	Number cartridges fired.	Number misfires.	Remarks.
Commenced firing, two laborers working gun.	A. M. S. 10 40 00	150	2	Mis-fires probably due to cartridges, as the caps were pierced.
Shifted barrels	10 42 00			
Fired for rapidity; spring-lock used, but the crank was not turned as fast as it might.	2 3	500	0	Gun worked smoothly, extracting well. The last cartridge jammed, but was cleared and extracted by forcing crank. No delay.
Fired for rapidity, Lieutenant Commander Pearson at crank, Gunner Walsh feeding.	53	300	0	Worked smoothly; barrel hot enough scorch, but not to light paper.
Cleaned parts with alcohol.				
Laborers turning crank for rapidity.	54	300	0	Worked well; no jamming.
Laborers took the mechanism apart and cleaned it.	30			No difficulty.
Commenced firing for endurance, and to see if heating would affect the parts; spring lock used, laborers turning, Gunner Walsh feeding.	11 23 10	375		
Shifted barrels	11 24 32	390		Worked smoothly; delay 5 seconds.
Shifted barrels and changed elevation.	11 26 59			Delay 15 seconds.
Shifted barrels	11 28 40	360		Delay 5 seconds; working smoothly.
Shifted barrels	11 29 30	375		Delay 4 seconds.
Shifted barrels and re-sighted.	11 30 59	315		Delay 40 seconds.
Finished	11 31 40	285		Results: Continuous firing of 2,100 shots in 8 minutes 30 seconds, counting all delays; no particular rapidity desired.
Recommenced, after cleaning the parts and barrels. The object being to see whether the firing of a number of shots would foul or heat sufficiently to affect action.	11 52 53	375		
Shifted barrels	11 54 08			Delay 6 seconds.
Feed delayed at.	11 55 06			Feed went on after forcing a little on crank, probably due to a bad shell
Shifted barrels and changed elevation.	11 55 38	375		delay 10 seconds.
Shifted barrels	11 57 00			Delay 20 seconds.
Shifted barrels	11 58 10			Delay 4 seconds.
Shifted barrels	11 59 25			Delay 10 seconds.
Stopped to cool, and to see whether the cold residuum would interfere with firing.	12 00 00	1,350		Delay 6 seconds.
Recommenced without cleaning; same lock, (spring.) Maximum depression about 35°.	12 7 30	300		In firing, the elevation was noticed to increase gradually, but this was found due to the sinking of the leg of the tripod in the ground.
Jammed	12 8 10			The firing-barrel was found to be hot enough to char paper; the next barrel to come into action could allow the hand to touch it without burning.
Started again	12 9 30	1,200		Opened case and found shell (marked No. 1) jammed; backed crank and took it out.
Shifted barrel	12 9 50			
Shifted barrel	12 11 53			Delay 1 minute.
Shifted barrel	12 13 45			Delay 37 seconds.
Shifted barrel	12 15 20			Delay 19 seconds.
A shell burst in carrier rolls.	12 16 4			Delay 15 seconds.
Ready to start.	12 17 02			The barrels seemed to shift badly, but it was found that if the crank was in the right place the shifting gear would work as at first.
Started again.	12 18 00	600		This was a hang-fire, and the shell is marked No. 2. It was necessary to back the crank and pick the shell from the flutes after removing lock and screw, which was easily done.
Stopped.	12 20 00			Six hundred shots were fired through last barrel. It was hot enough to readily light paper; but the shifting gear worked easily.
Tried the traversing gear	1 15 00	300	0	Worked very well, dispersing the shots evenly. The handle to alter the dispersion accomplished its object.
Tried pressure lock without the spring.	1 55 00	30	0	Fired slowly, and worked well.

and Spring.



Plunger.

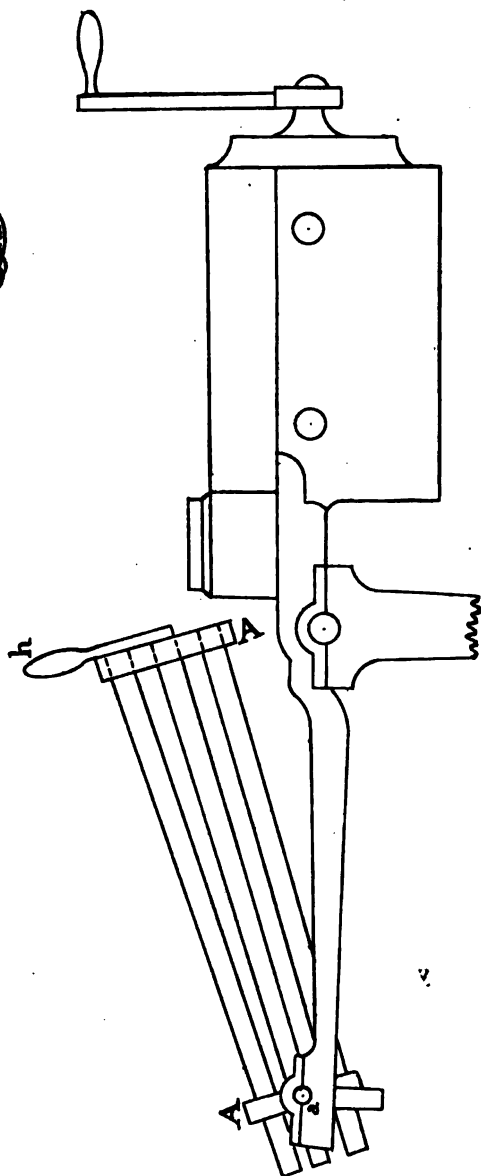








**FIG 5**





	Time.	Number car- tridges fired.	Number miles fired.	Remarks.
Commenced rapid firing with same.....	A. M. S. 1 57 32	180	} 16 miles fired in 600	Shell marked No. 3 had burst in the rolls—probably a hang-fire; a portion of the shell and the bullet were left in the gun. The firing might have gone on in 40 seconds, but the parts were taken out of the barrel with little difficulty.
Jammed .....	1 58 00	.....		
Recommended .....	2 1 30	} 420		
Jammed .....	2 20			
Put in spring-lock, having cleaned the mechanism; (this cleaning was done with alcohol and a rag)	2 8 10	.....		
Shifted barrels .....	2 9 20	450	.....	Delay 7 seconds.
Shifted barrels .....	2 11 15	450	.....	Delay 6 seconds.
Stopped .....	2 14 40	495	.....	
Total .....	.....	9,875	.....	

Nine thousand eight hundred and seventy-five rounds were fired altogether during the day, the crank being worked and the cartridges fed by two colored laborers who had never seen the gun until brought to the battery. They also readily dissected the gun—removing the three parts, lock and two carrier-rolls, the only parts liable to any derangement, or that might require cleaning.

In order to test the working of the feed when firing at a depression, the gun was depressed  $35^{\circ}$ , in which position twenty one hundred rounds were fired, the feed working as well as when fired level.

Two cases of hang-fires occurred, the cartridges exploding after or while being extracted; but being still inclosed in the "flutes" of the strong "carrier-rolls," no damage was done to the mechanism. In one of these cases the bullet remained in the barrel, but the barrels being lifted into the position shown in Fig. 5, it was readily backed out with an ordinary cleaning-rod. The firing could have been continued by shifting to another barrel, without attempting to remove this bullet, though it was removed in forty seconds. These cases of hang-fire being probably the result of defective cartridges, and not due to the gun, are only noticed to show the advantage of the "carrier-rolls;" they being made of steel are not easily injured, even by a cartridge exploding between them.

In the afternoon the gun was removed from the butt to a point near the bay, and two hundred rounds were fired over the water, the object being to show the effect of the fire when using the traversing-gear, (which is full illustrated and described in Commander Sicard's report, Fig. 10.) We recommend the traversing-gear to be so arranged as to give a greater spread to the fire, which it will be seen, by reference to the illustration in Commander Sicard's report, Fig. 10, can be readily done without at all altering its design.

It is the perfection of a traversing gear, because the amount of traverse can be regulated from nothing up to the full amount permitted; so that the person operating the gun can spread or reduce the space covered by his fire, according as the object approaches or recedes, increases or diminishes its front, without stopping the fire. As now arranged, the throw of the traverse is only three eighths of an inch, which gives but 80 feet dispersion in a thousand yards.

In Commander Sicard's report, it is noticed that the heating of the firing barrel caused it to jam by expanding against the rear bearing. In the present trial this is obviated by allowing a play of three-sixteenths of an inch in the forward bearing, permitting the barrels as heated to expand forward.

After rapidly fixing six hundred rounds from one barrel, it was heated sufficiently to light paper; but it gave no trouble in shifting barrels.

The following principal points were particularly noticed:

1st. *Feed.*—This comprises the feeding-tube and carrier-rolls; the former keeping each cartridge horizontal till it is received by the latter, the carrier-roll. They are certainly an important addition to the mechanism of a machine-gun; preventing the cartridges from accumulating before the lock, bringing the cartridge in line with the firing barrel, receiving the empty shell as it is withdrawn, and carrying it down clear of the gun; in other words, it receives and takes charge of each and every cartridge in succession from the moment it drops into the flutes until it is fixed and extracted; all its movements being exposed, and acting with certainty.

2d. *Extraction.*—The double extractor, grasping as it does the butt of the cartridge on both sides, works with very great certainty. This certainty is not only due to the fact of the extractors not depending on their spring or elasticity, but to a positive movement being given to their hooks by a shoulder on the lock-plunger, working on the curved portion of their rear ends. Thus the extracting-hooks are obliged to retain hold of the flange of the cartridge until entirely extracted, when the empty shell is readily removed from the hooks by the carrier-rolls, as already explained.

3d. *Lock-mechanism.*—The general working of the spring-lock is similar to those used in the Gatling gun, but is much more accessible; being readily removed, if necessary, in a few seconds. We do not see any particular advantage, if any, in the working of the pressure-lock over the percussion-lock.

4th. *Accessibility of parts.*—The working parts being exposed by simply turning back their cover, allows the mechanism to be at once seen and readily removed, and in this respect is as simple as the Gardner gun, and far more so than the Gatling gun; and, whenever a stoppage may occur, its cause is *immediately seen*, and easily remedied. This feature of this gun is to be highly recommended.

5th. *Accuracy of fire.*—The gun during this trial not being tested for accuracy, we cannot say that it is either inferior or superior in this respect to other machine-guns. But as it fires all its shots from one barrel at a time, it would not appear to be liable to the irregularity of accuracy, which might occur were any of its barrels thrown out of line.

6th. *Fouling.*—Four thousand two hundred rounds were fired without cleaning, an interval of fifteen minutes being allowed to elapse, after two thousand one hundred rounds were fired, before the firing was resumed; sufficient time to allow the barrel and working parts to cool, and thus harden any residuum that had collected. The gun worked as well apparently, firing with the same regularity and rapidity as when clean, up to the end of this trial.

7th. *Loss-motion at firing-point to allow for hang-fires*—This is a point of considerable importance. The shape of the cam which operates the lock is such, that after the plunger has shoved the cartridge into the barrel, and it has been fired, it continues to be supported in rear by the cam during a portion of its revolution. This is clearly shown in Commander Sicard's report, (Figs. 3 and 4.) This arrangement is of great

FIG. 10.

The Saddle traversing and the Gun steady.

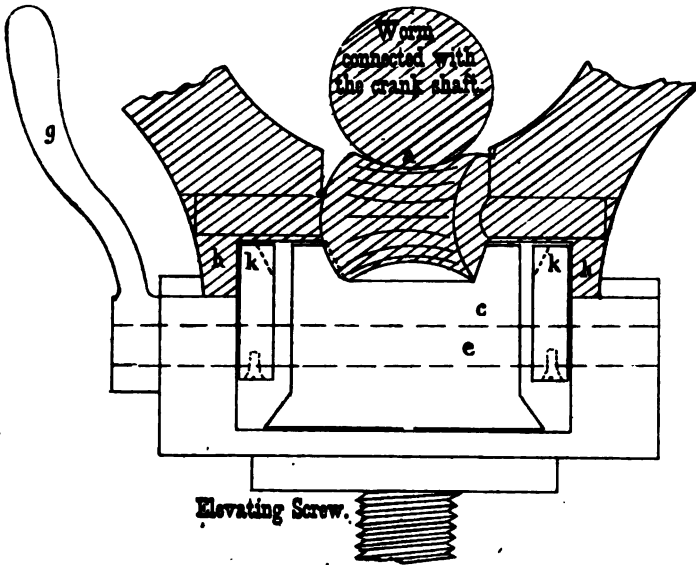
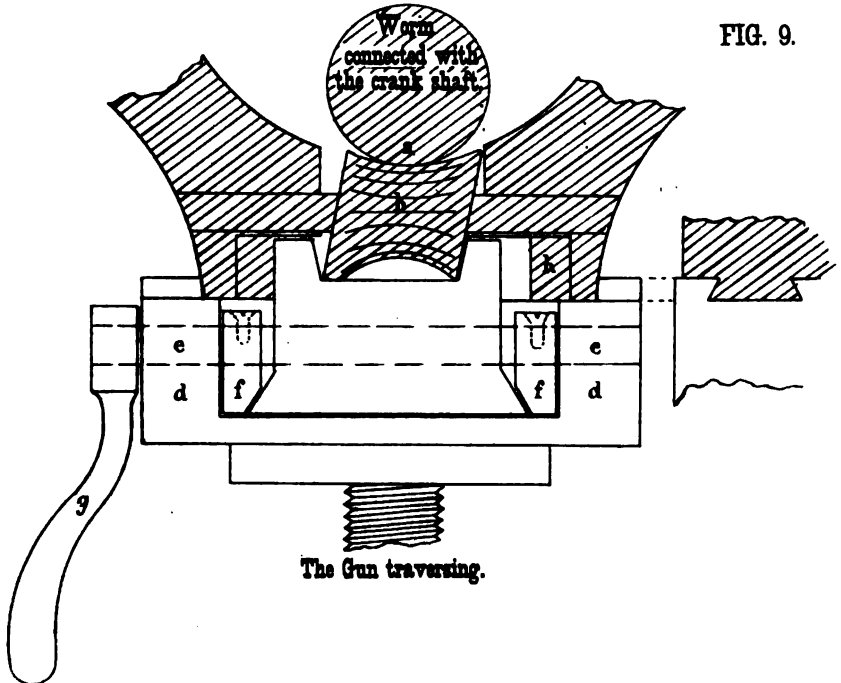


FIG. 9.



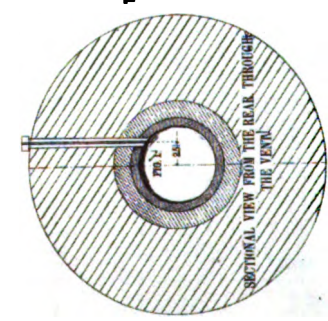
The Gun traversing.





# **XI in. S. B. GUN, CONVERTED INTO AN 8 in. M. L. RIFLE.**

*Approved for use  
by the War  
Dept. in 1894*



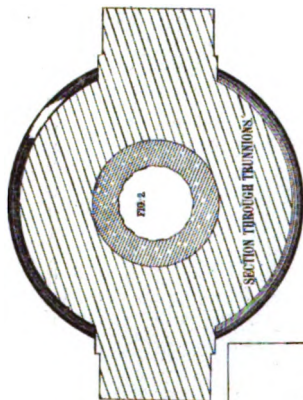
**DETAILS.**

Twist uniform, one turn in 48 in.

15 Grooves and lands,  
each 0.55772 in. wide.

Grooves 0.475 in. deep.

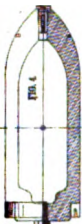
Weight 18000 lb.



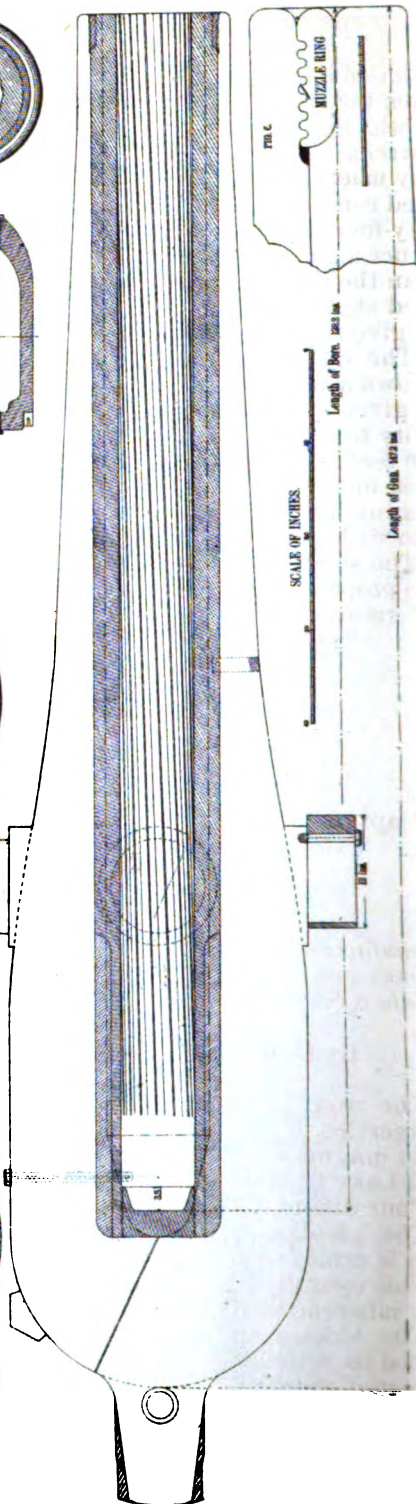
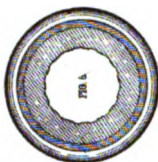
**8 in. BATTING SHELL OF 180 LBS.**



**8 in. SHELL OF 180 LBS.**



**VIEW AT MUZZLE.**



SCALE OF INCHES.

Length of Bore, 102.1 in.

Length of Gun, 102.1 in.

FIG. C.

MUZZLE RING

value to a machine-gun, where the cartridges are entered and extracted from the barrel with such rapidity that hang-fires are liable to occur.

8th. *Rapidity of fire.*—This gun, firing as it does all its shots from one barrel at a time, compares in this respect very favorably, indeed, with any machine-gun. Twice during this trial three hundred shots were fired considerably within a minute, the actual time being fifty-three and fifty-four seconds, respectively. It is proposed by the inventor to construct a gun with double the number of barrels, making eight, (two less than the Gatling gun,) with two locks, so that a fire of four or five hundred shots a minute can be steadily maintained without being obliged to give a too rapid motion to the crank.

The question of rapidity of fire being well established for all well-known machine-guns, we think the points to which attention should now be given in the trial of a machine-gun are simplicity of mechanism, liability to get out of order, and accessibility of parts. In these are included the feed and extracting, also durability. We think these points have been more highly developed in the Lowell Battery Gun, and its mechanism brought to a nearer state of perfection, than in any other machine-gun with which we are acquainted.

The shells which are referred to in the "record of firing," and one of the proposed cartridge cases, are respectfully forwarded herewith for the information of the bureau.

Very respectfully, your obedient servants,

A. S. CROWNINSHIELD,  
*Lieutenant-Commander, U. S. N.*

EDWARD W. VERY,  
*Lieutenant, U. S. N.*

B. H. BUCKINGHAM,  
*Lieutenant, U. S. N.*

Captain WILLIAM N. JEFFERS,  
*Chief of Bureau of Ordnance, Navy Department.*

*Manufacture of wrought-iron tubes for the conversion of XI-inch Dahlgren guns into 8-inch muzzle-loading rifles, and the 100-pounder Parrott rifle into a breech-loading rifle tubed with wrought-iron.*

By Commander F. J. HIGGINSON, *Inspector of Ordnance.*

The iron for the tubes is obtained from the Ulster Iron Works, at Saugerties, N. Y., and is made from the best American pig-iron, selected from magnetic and hematite ores taken from the mines of New Jersey and Lake Champlain.

Four different kinds of pig-iron are mixed in the puddling-furnace.

The puddled balls are first passed under a trip hammer, where the slag is removed and the ball formed into a bloom.

This operation is very carefully watched, and balls showing signs of any inherent weakness or want of proper puddling are rejected.

The blooms are rolled into slabs, then cut into short pieces, piled, raised to a welding heat, and again rolled into slabs. This process is repeated three times, great care being taken at each piling to preserve the direction of the grain, or fiber, of the iron.

The last pile from which the bar is finally rolled is composed of 17 slabs, 51 inches long and 7 inches wide; the top and bottom slabs are each  $\frac{3}{4}$  of an inch thick, and the intermediate ones  $\frac{1}{2}$  an inch.

This pile is placed in an anthracite furnace, raised to a welding heat, and passed through a succession of rollers of gradually diminishing dimensions until it is finally rolled into the bar required for making the tube.

This bar is 18 feet long, and tapers from 4 inches on the outside to  $3\frac{1}{4}$  inches on the inside, and is  $3\frac{1}{2}$  inches thick.

When this bar is subsequently rolled into a coil, the inside next to the shaft,  $3\frac{1}{4}$  inches, expands and the outside contracts, making it  $3\frac{1}{2}$  inches square.

The slabs in this bar stand vertical in the direction of its length, and in the subsequent coil-welding, which takes place on the side of the bar and against the flat of the slabs, they are drawn more solidly together.

The iron of these bars breaks at a tensile strain of 50,000 pounds to the square inch, and presents, when fractured, a bright fibrous appearance, indicating great tenacity of character.

The operation of making a tube is divided into three parts, viz: rolling, coil-welding, tube-welding.

#### ROLLING.

The bar to be rolled into a coil is 36 feet long, two of the original bars being welded together with a tongue-weld.

This bar is placed in a long furnace and heated by a blast to a good red heat, it is then drawn out and rolled around a shaft  $6\frac{1}{2}$  inches in diameter, and slightly tapering at one end.

The shaft with the coil upon it is then lifted by a crane from its bearings, and the coil slipped off the tapering end; it is received upon a flat iron plate, where it is allowed to cool without losing its alignment.

#### COIL WELDING.

The coil to be welded is placed on the end of a long porter-bar, having a movable balance-weight on the other end, and laid horizontally in a reverberatory furnace. When the coil arrives at a red heat it is taken out of the furnace on the porter-bar, and shoved into an iron pipe which is canted on its side to receive it, this pipe is made of strong cast iron four (4) inches thick, four (4) feet long, and with an interior diameter of fourteen (14) inches; the pipe with the coil inside is then drawn vertically under an 8-ton steam-hammer and given a few light blows to force the coil firmly together; it is then replaced in the furnace, and when raised to a welding heat is again placed in the pipe under the hammer and receives seven or eight welding blows; this welding process is repeated, after which the coil is allowed to cool.

This process is considered the most important of the whole operation, as any impurities lodging between the folds of the coil before they are closed, or too great a loss of welding heat between the furnace and the hammer, will prevent a perfect welding of the coil.

The use of a pipe for coil welding is different from the method pursued in England and is thought to be superior.

#### TUBE WELDING.

The welded coils are first bored out sufficiently to detect any flaws and their ends faced and reciprocally recessed for shrinking together.

The projection or shoulder is slightly longer than the depth of the



recess, so that when the coils are pressed together in the furnace the first welding will take place in the interior; the recess is expanded and shrunk over the shoulder, thus holding the two coils together while being placed in the furnace; the joint is then placed in a reverberatory furnace eighteen (18) inches wide and five feet long, having in the center a door on each side through which the ends of the coils project, and the blast falls only on the joint.

A cross-head supported by two iron bars is placed against one of the projecting ends, while a screw-press of one hundred tons is brought to bear on the other end.

As the joint arrives at a welding heat, the press is screwed up and the coils driven into each other.

Two coils united form a section, and two sections similarly united form a tube.

When judged sufficiently united, the section is withdrawn from the furnace and the bulging around the joint straightened under the hammer.

The welded tube is then bored out to within one-tenth of its final diameter and a cut is taken off the outside.

It is then carefully inspected, and subjected to a water-pressure of one hundred and forty (140) pounds.

After inspection the tube is put in the turning-lathe and turned down at the breech to receive the B tube.

The B tube is made from a welded wrought-iron coil, constructed in the manner already described, and thirty-two (32) inches long and one and seventy-five hundredths ( $1''.75$ ) inches thick; it is shrunk over the breech end of the main or A tube with a shrinkage of  $0''.003$ , the A tube having previously been turned down ( $1''.75$ ) to receive it. Around this reduced portion of the A tube a spiral groove or gas-escape  $0''.05$  deep and  $0''.1$  wide is cut, which communicates with a small hole bored through the breech when the tube is in position in the gun.

This arrangement of the B tube and gas-escape is a safety measure, the intention being that any fracture of the A tube underneath the B tube sufficient to allow the escape of gas into the groove will immediately be indicated at the breech of the gun, and give timely warning of the danger within.

A screw-plug,  $5''.5$ , closes the breech-end of the tube and forms the bottom of the bore.

The tube is next taken to the rifling-machine and rifled on the following dimensions, viz:

Twist, uniform; one turn in forty (40) feet, 15 lands and grooves, each  $0''.83776$  wide; grooves,  $0''.075$  deep.

Rifling commences  $10''$  from bottom of bore.

After rifling, the tube is fine-turned to fit the gun.

The dimensions of the finished tube are as follows, viz:

Length =  $131''.2$ ; thickness,  $2''.75$ .

Length of bore =  $128''.2$ .

Diameter of bore =  $8''$ .

The XI-inch gun into which this was fitted was first bored out to a diameter of  $13''.5$ , and a thread for the screw-collar cut around the muzzle.

To this cast-iron casing the tube is fitted, using points and horseshoe gauges. The play should not exceed  $0''.007$  at the breech, nor  $0''.015$  at the muzzle.

A small threefold purchase was used to haul the tube into the casing. It is secured in the muzzle between the tube and the casing.

A small pin, or steadying-plug, is secured through the casing and into the tube on the side just forward of the trunnions, to prevent the tube from turning.

As the preponderance of the guns was changed after conversion from plus to minus at the base-ring, the axis of the trunnions was carried forward 1".5, by first turning them down eccentrically and then fitting on a composition sleeve.

The present preponderance is plus 300 pounds at the base-ring, and the weight of the converted gun is 17,330 pounds.

As the converted guns are to be fired with friction primers, the lock masses have been removed; the vent-piece, which is of copper 1" in diameter, is screwed in through the casing and tube, and has a nut and shoulder on the upper end.

*Proof-firing.*—The guns when finished were subjected to a proof-firing of ten (10) rounds; five (5) of these rounds were with 20 pounds of hexagonal powder, and five (5) with 35 pounds—the shot in each case weighing 180 pounds.

The expansion of the wrought-iron tubes during proof may be seen from the following table.

The point taken in each gun is 118 inches from the muzzle and about the center of the cartridge when in the gun.

The play of the tubes has been deducted:

No. of gun.	Enlargement.	No. of gun.	Enlargement.
165—1 .....	0".016	171— 7 .....	0".021
166—2 .....	0".027	172— 8 .....	0".016
167—3 .....	0".014	173— 9 .....	0".021
168—4 .....	0".019	174—10 .....	0".021
169—5 .....	0".018	181—11 .....	0".019
170—6 .....	0".017	Average enlargement.....	0".0199

The enlargement in the powder-chamber gradually diminishes toward the muzzle, and at distance 68" from it no appreciable expansion can be found. Where the expanding-ring takes the grooves, the expansion suddenly increases for two or three inches, and then as suddenly decreases. This occurs at a distance of 100" from the muzzle, or 28" from the bottom of the bore.

As the 35-pound cartridge occupies 24" from the bottom, and the shot when home is placed close against it, inference seems to be that the shot has a forward movement of 4" before the ring takes the grooves; with a 20-pound charge it would be somewhat more.

The velocities obtained during proof with Benton's thread velocimeter were as follows, viz:

Charge of powder.	Number of fires.	Average initial velocity.
20 pounds.	16	1,200.0 feet.
35 pounds.	23	1,466.7 feet.

The velocities were taken at a distance of 175" from the muzzle of the gun, and with 1° depression.

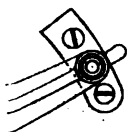
The following table will show the pressure during proof, viz:

Charge.	Number of fires.	Average initial pressure.
20 pounds.	13	20.746
35 pounds.	14	30.080

As the shot were fired in a butt, no ranges were obtained.

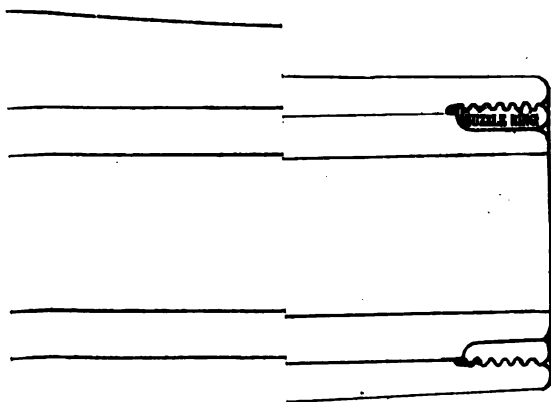
No flaws or imperfections of any kind were developed during proof.

Considering that these eleven tubes manufactured for the Navy were the first of the kind ever made in this country, the success of the attempt is assuring; more particularly as it is stated in an English work



version of **100 Pdr.**

By the inse



*H. J. J. J.*  
*Baran*



that "the difficulty of obtaining a perfect coiled tube was at one time so great that two out of every three were rejected."

*Conversion of the 100-pounder Parrott rifle into a breech-loader.*—The breech of the rifle to be converted was first cut off at a distance of 1" from the base ring and the bore enlarged to receive a wrought-iron tube, inserted from the rear.

The gun was bored out to a diameter of 11".75 from the breech to the trunnions, and to a diameter of 10".4 from the trunnions to the muzzle, the larger diameter at the breech corresponding to a greater thickness of the tube in that portion.

A screw-thread for a collar was cut in the cast iron, both at the breech and at the muzzle.

The band was not removed and remains the same as in the old gun.

The wrought-iron tube fitted to this casing was made of five welded coils constructed and united together in the same manner as those for the 8-inch muzzle-loading rifle.

The two breech or reinforce coils of the tube were made with 3½" bar-iron, and the other three coils with 2¾" bar-iron, and they were all rolled on a shaft 5½" in diameter; where the re-inforce portion of the tube ceases, a shoulder is rounded off to fit the casing.

The welded tube after having been bored out to its final diameter, (6".4,) was put in the lathe and turned down as nearly as possible to the same diameter as the bore of the casing.

The tube, when finished, has the following dimensions, viz :

Length .....	139"
Length of re-inforce .....	45".5
Length of screw-box .....	10".2
Thickness of re-inforce .....	2".675
Thickness of tube from re-inforce to muzzle .....	2"
Diameter of bore .....	6".4
Length of bore .....	125".7

In turning the tube to fit the casing the muzzle-end was given a slight taper to facilitate its entry; the gun and tube were then placed in a strong iron frame, which consisted of two cross-heads connected together by two heavy iron side-rods.

The muzzle of the gun was placed against one cross-head and the tube forced in from the rear by two 30-ton hydraulic jacks supported by blocks against the other cross-head; after the tube had been forced home by the jacks, a collar 3¼" wide was secured in at the breech, between the tube and the casing, and similar one at the muzzle.

The gun was then put in the turning-lathe and the breech-end of the tube bored and fitted to receive the breech-plug and Broadwell ring; it was then taken to the rifling-machine and rifled on the following system, viz :

Twist uniform, one turn in 32 feet.

Twelve (12) lands and grooves, each 8".83776 wide.

Depth of grooves, 0".075.

The apparatus for closing the breech of this gun is on the French system, and consists of a steel plug 9" long and 0".67 in diameter, around the circumference of which is cut a screw-thread corresponding to the one cut around the screw-box in the tube; the plug and screw-box are reciprocally slotted in three places, so that it can be shoved down to its bearings by hand before engaging the threads.

In cutting the slots on the plug, the outer thread is not cut through, and prevents the plug from entering beyond the point where the threads will take each other fairly.

On the inner face of the breech-plug a circular nose plate is fitted, which is held in position by a central bolt which passes through a hole in the center of the plug, and is set up with a screw-nut which is recessed into its outer surface.

This nose-plate is of steel, and bears tightly against the Broadwell ring when the breech-plug is ready for firing.

The vent passes through the center of the bolt holding the nose-plate.

The inner surface of the nose-plate has been left flush, and a small piece of copper sewed to the bottom of the cartridge acts as a gas-check in firing.

On the outer end of the plug is screwed a bronze facing, which consists of two handles, a lever-arm and a movable vent-guard.

A bronze frame or bracket is hinged to the rear of the gun on the right of the bore, and is so hung that when the breech-plug is drawn from the gun it slides directly into this bearer, and is swung to the right, leaving the bore clear for loading.

When the gun is loaded the bearer is swung toward the bore, and bringing up suddenly against the gun, the breech-plug slides off into the slots, and where it also brings up the lever-arm is turned  $60^{\circ}$  to the right and caught with a spring.

The vent-guard is so arranged as to be closed by the action of the lever-arm in unlocking, and remains closed until moved off by hand, after the plug is again screwed up for firing.

The gun cannot be primed until this has been done.

*Conversion of a 100-pounder Parrott rifle into a breech-loader on the French system.*

The breech of the 100-pounder to be converted was cut off at the base-ring, and the band removed by heating and expanding it in a charcoal fire.

The gun was then bored out for a distance of 58".2 from the base-ring, the diameter of the boring being 11".75 for the first, 12".5 and 8".30 for the remaining distance.

Around the enlarged portion of the boring a coarse female screw, of five threads, was cut to correspond with a screw cut around the outside of the re-inforce portion of the steel lining.

This screw is left-handed, so that the tendency of the rifle motion (right-handed) would be to tighten the tube.

The steel tube or lining fitted to this casing was made from an ingot of tough cast steel obtained from the Midvale Steel Works, Pennsylvania. When turned and bored as required, its dimensions were as follows:

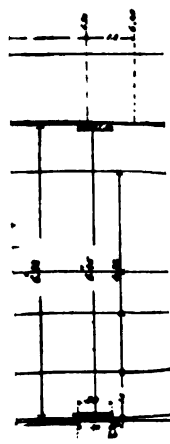
Length .....	58".2
Length of re-inforce .....	12".5
Thickness of re-inforce .....	1".85
Thickness of tube forward of re-inforce .....	1".45
Diameter of bore .....	6".4
Diameter of screw-chamber .....	7".5

A screw-thread is cut around the outside of the re-inforce portion of the tube, which was turned to an exterior diameter 0".001 greater than the interior diameter of the casing.

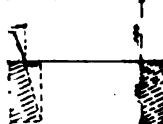
To fit the tube into its casing, the latter was placed in a vertical charcoal-furnace, with the muzzle down and the top of the furnace cun-  
ing flush with the breech where it had been cut off, thus leaving the bore clear for entering the tube.

\_\_\_\_\_

\_\_\_\_\_



Profile of Edge of Road







The heat circulated in the furnace around the outside of the casing, and the tube was suspended from a crane over the bore.

When the casing was sufficiently expanded the tube was lowered into the bore and screwed firmly into place.

The old band which had been removed was increased from 27" to 39" in length, bringing it forward to within 2".75 of the rimbase.

The new band was expanded in a charcoal fire and shrunk on the gun with a shrinkage of 0".062.

The gun was then put in the rifling-machine, and the rifling which remained in the original bore was continued onto the tube.

This rifling was on the following system :

First increased from zero to one turn in 19' at muzzle.

Equal lands and grooves each 1".2566 wide.

Length of bore.....	128'
Length of rifling.....	124"

The breech-closing apparatus fitted to this gun is the French screw-plug with central fire, the same as that fitted to the 100-pounder Parrott rifle converted into a breech-loader by the insertion of a wrought-iron tube, with the addition of a lever, rack, and pinion, to give additional power for opening and closing breech. This is done to show the system as applied to heavy guns, but is not necessary for this caliber.

Respectfully submitted.

F. J. HIGGINSON,  
*Commander, and Inspector of Ordnance.*

*Description of naval 3-inch breech-loading howitzers, with instructions for their use and care.*

NOMENCLATURE FOR 3-INCH BREECH-LOADING HOWITZER OF 350 POUNDS.—PLATE II

*Gun.*

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Cheeks.</li> <li>2. Cheek-fillets.</li> <li>3. Breech-face.</li> <li>4. First cylinder.</li> <li>5. First fillet.</li> <li>6. Second cylinder.</li> <li>7. Second fillet.</li> <li>8. Chase.</li> <li>9. Rimbases.</li> <li>10. Trunnions.</li> <li>11. Muzzle-face.</li> <li>12. Elevating lug, (with slot, pin-hole, and pin.)</li> <li>13. Rear sight-bar.</li> </ol> | <ol style="list-style-type: none"> <li>14. Sight thumb-screw.</li> <li>15. Trunnion-sight.</li> <li>16. Cheek-hinge.</li> <li>17. The screw-box, (or plug-nut.)</li> <li>18. Breech-screw, (or nut-fillets.)</li> <li>19. Breech-blanks.</li> <li>20. Breech-slope.</li> <li>21. Breech-face.</li> <li>22. Powder-chamber.</li> <li>23. Shot-chamber.</li> <li>24. Centering-slope.</li> <li>25. Compression-slope.</li> <li>26. Bore.</li> </ol> |
|--|---|

*Breech-mechanism.*

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>27. The collar.</li> <li>28. Collar-hinge.</li> <li>29. Collar-lands.</li> <li>30. Collar-grooves.</li> <li>31. Guide-bolt masses.</li> <li>32. Latch-mass.</li> <li>33. Catch-mass.</li> <li>34. Face of collar.</li> <li>35. Round of collar.</li> <li>36. Collar-guide.</li> <li>37. Collar-locking faces.</li> </ol> | <ol style="list-style-type: none"> <li>38. The breech-plug.</li> <li>39. Slotted screw-threads.</li> <li>40. Closing-blanks.</li> <li>41. Locking-blank.</li> <li>42. Plug-locking faces.</li> <li>43. Guide-bolt slots.</li> <li>44. Latch-slot.</li> <li>45. Plug-flange.</li> <li>46. Flange-rim.</li> <li>47. The hollow.</li> <li>48. The hand-gripe.</li> </ol> |
|---|---|

- |                           |  |   |
|---------------------------|--|---|
| 49. The lever.            |  | 54. Nose-plate; one for metallic cartridge,<br>one for serge-bag. |
| 50. The handle.           |  | 55. Nose-plate recess   |
| 51. The nipple.           |  | 56. Nose-plate boss.  |
| 52. The catch, (or snap,) | { loop, <i>a</i> .<br>{ nose, <i>b</i> .<br>{ shank, <i>c</i> .<br>{ nose, <i>a</i> .<br>{ tail, <i>b</i> .<br>{ shank, <i>c</i> .<br>{ head, <i>d</i> . | 57. Boss-recess.  |
| consisting of—            |  | 58. Nose-plate screws.  |
| 53. The latch, consisting |  | 59. Vent-check, (with guide-screws.)                              |
| of—                       |  | 60. Guide-bolt, (for collar.)                                     |

*Broadwell ring.—Full size.*

- |                |                        |
|----------------|------------------------|
| 61. Ring-face. | 65. Front.             |
| 62. Flange.    | 66. Nose-plate flange. |
| 63. Curve.     | 67. Ring-grooves.      |
| 64. Crown.     |                        |

## GENERAL DESCRIPTION.

For some time experiments have been going on with a view to the introduction of breech-loading rifled boat-howitzers into the Navy, and it is thought that the armament described in the following pages will be found suitable for the purpose in view.

Two sizes of the 3-inch rifle are adopted, and when made of bronze they will weigh 350 and 500 pounds, respectively. For the present, both classes will fire projectiles of eight pounds' weight; the propelling charge being twelve ounces of large-grain cannon-powder for the light, and sixteen ounces for the heavy gun. This charge is inclosed in an ordinary serge cartridge-bag.

Plate II shows the profiles of the light gun. It will be seen that the exterior consists of two short cylinders forming re-inforces, and a truncated cone forming the chase. These are connected with one another by fillets.

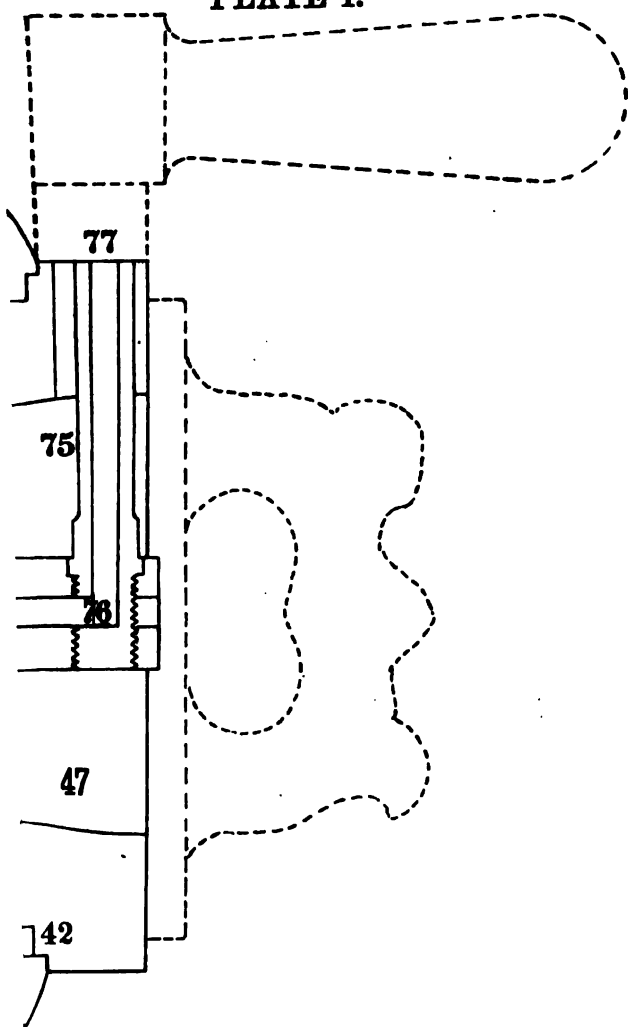
In the heavier gun the second or smaller cylinder is dispensed with, and the chase is carried back to the first cylinder. In both patterns the rimbases are connected to the chase by heavy fillets.

At the rear end of the first cylinder a flat cheek, 1, is worked on each side of the gun, and an elevating mass, or lug, (12,) underneath. The right cheek carries the collar-hinge, the left receives the nose of the collar-latch, and also holds the tangent-sight, which is set at a permanent angle of two degrees to the left of the vertical in order to allow for drift of the projectile. The cheeks are joined to the first cylinder on all sides (except to the rear) by fillets, as is also the elevating-lug. The rear faces of the cheeks, and also that of the elevating-lug, form one with the general plane of the breech.

The bronze ingots for these guns are run solid, in a cast-iron chill-mold, muzzle down, the mold being somewhat longer on breech and muzzle than the neat length required for the finished gun. The thickness of the chill-mold is a semi-diameter of the ingot at each point of its length, and the diameter of the ingot is one-half an inch greater than that of the finished gun.

Before being turned upon the outside the guns are smooth-bored to a diameter of 2.62 inches, and then the bore is enlarged (by the successive passage of ten steel mandrels, increasing gradually in size) to a diameter of 2.92 inches. This treatment takes about ten per cent. of the extensibility out of the metal composing the walls of the bore. (Note I.)

# PLATE 1.





The guns are rifled with a regular right-handed twist, and show at the muzzle sixteen ribs and sixteen grooves of equal breadth; the ribs having a height of four-hundredths of an inch.

The inclination of the rifling is six degrees from an element of the bore on the driving side of the rib, and somewhat less on the reverse side; making the width of the rib two-hundredths of an inch less at the seat of the shot than at the muzzle.

Toward the bottom of the bore, and immediately in rear of the full rifling, is found the "shot-chamber." The diameter of the bore proper after mandreling is 2.92 inches across the ribs and 3 inches to the bottom of the grooves.

When the shot-chamber is reached, however, the ribs are cut away—by a slope—toward the rear, having an inclination of four-hundredths of an inch (the depth of the rib) in two inches of length. This incline is called the compression-slope; it receives the belt of the projectile, (when loaded,) and centers the latter while in the loading position and as it is being driven into the bore. (Plate I, 25.) To the rear of this compression-slope the chamber continues on at a somewhat quicker inclination, connecting the shot-chamber with the powder-chamber. The latter (Plate II, 22) is also a truncated cone, and has a diameter at the forward end of 3.20 inches, that of the rear end being 3.25 inches where the "ring-recess" is reached.

This recess is a short cylinder 0".39 long. It contains the Broadwell gas-check ring, and is connected with the powder-chamber by a "round" of eight-hundredths of an inch radius. (Plate I, 68.)

Immediately in rear of the ring-recess is found the "screw-box." (Plate I, 17.) It is united to the ring-recess by a heavy fillet. The screw-box has a female screw chased upon its surface, the thread having the same profile and pitch as that cut upon the breech-plug. Three equidistant "blanks" are planed longitudinally through the thread, each one removing one-sixth of the surface. One blank is found at the lowest part of the screw-box, and the other two equidistant from the first, around the interior surface.

In rear of the screw-box is the "guide-recess," (Plate I, 69,) a shallow circular hollow in the rear face of the breech, having its sides inclined. As the collar closes, a projection or guide on its forward face fits into this recess and directs the axis of the collar into coincidence with that of the screw-box, thus insuring the easy entrance of the breech-plug. Immediately in rear of the guide-recess the gun is terminated by a plane, passed perpendicularly to the axis of the bore.

The lug for the elevating-screw is placed vertically under the first cylinder of the gun, and at its rear end. It is slotted in a longitudinal direction to receive the head of the elevating-screw, and is pierced laterally with a hole, which receives a  $\frac{3}{4}$ -inch pin used for coupling the head of the screw to the gun.

#### *The breech-mechanism.*

After the gun is loaded, the opening in rear of the powder-chamber is closed by the breech-plug, (Plate II, 38,) which is secured in its place as follows:

The plug (which is a cylindrical piece of bronze or soft steel) has a thread cut upon it, having the same pitch and profile as that cut on the interior of the screw-box in the breech of the gun. One half of the bearing surface of the plug-thread must be cut away, (in the same manner as has already been described for the screw-box,) and the area thus to be

removed is distributed into three longitudinal blanks, cut at equal intervals around the engaging surface.

We thus have on the plug, and also in the screw-box, three sections of screw-threads, separated by blanks, running parallel to an element of the bore, forming a slotted screw.

In order to lock or secure the plug into the rear of the bore, it is only necessary to match its threaded sections to the blanks of the screw-box and to push the plug at once home. A turn to the right of one-sixth of the circle then engages (at the same time) all the threads of the plug with those of the screw-box; after which the plug is ready to oppose the effort of the charge. (Note II.)

In rear of the threaded sections the plug is plain (Part I, 41) where it works circumferentially in the collar, and it is terminated at the rear end by a flange, having its forward side furnished with locking-faces, (42,) the use of which will be explained further on. The rear end of the plug is deeply recessed, in order to obtain lightness; the forward end is terminated by a flat face, which is recessed in the center to receive the boss of the nose-plate, (56.)

The plug is also pierced with an axial hole (70) one inch in diameter.

The nose-plate is made of steel, and is somewhat less in diameter than the body of the plug. It presents the appearance of a low truncated cone, terminated by two short cylinders. On its rear surface it has a boss, (56,) from which projects the stem, (71,) which passes through the hole in the axis of the plug. A nut (72) runs upon this stem, and, bearing against the forward face of the hollow, enables us to bring the nose-plate to a firm bearing against the forward face of the plug.

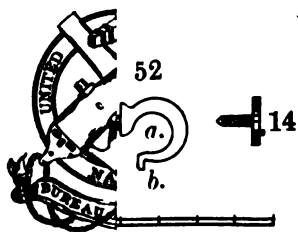
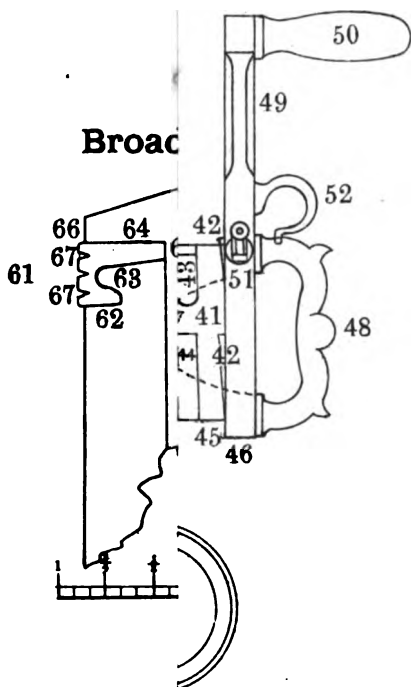
The forward face of the nose-plate bears against the gas-check ring (73) when the breech is locked. The vent passes entirely through the axis of the nose-plate and stem, the rear orifice being found in the center of the after end of the stem, and the forward one in the center of the nose-plate.

At the latter point the nose-plate is recessed, (74,) and a gas-check (59) is fitted over the orifice of the vent. This vent-check, as it is called, consists of a disk of mild steel, secured over the interior orifice of the vent by four steel screws, which pierce through the disk perpendicular to its flat surface and near its edge. The screws are equidistant from one another, and their heads are not set down hard upon the disk, but allow it to rise about five-hundredths of an inch. The pressure of primer-gas through the vent pushes the disk forward and admits flame to the charge; then the pressure of gas arising from the combustion of the charge forces the disk firmly back upon the orifice of the vent, and prevents all leakage in that direction. (Note III.) The shanks of the four securing screws act as guides to the disk during its motion.

As before remarked, the outer orifice of the vent is found at the rear end of the axis of the stem; but as this is not a convenient place from which to fire the primer, a secondary or offset vent is drilled nearly through a short cylinder of steel, 75, (Plate I,) the lower end of which is made to pass vertically down through the nose-plate stem near its rear end. The lower end of the vent in this cylinder is turned at right angles and comes out in the axis of the main vent, as shown at 76.

It will be seen that if a primer is fired at 77, the gas has free passage to the forward orifice of the main vent, but is stopped off toward the rear. The upper end of the cylinder containing the secondary vent is inserted (from below) through the upper part of the plug-flange, and comes out very conveniently for priming. (Note IV.)

It will be understood from what has preceded that the nose-plate is







movable longitudinally by loosening or tightening the nut upon the stem. The object of this is to allow of the nose-plate face being brought up against the Broadwell ring, even if the plug should be found set to the rear somewhat after repeated firing. In such a case the nose-plate will be brought forward by liners (in the form of flat rings of the necessary thickness) inserted behind the rear bearing faces of the plate at 56 and 78.

The plate is then replaced in the plug, and the nut being set up taut, the forward face of the nose-plate should be found to bear against the ring. Care must be taken to have the outer and inner liners of equal thickness. (Note V.) It is not necessary that the nose plate should press the ring *very* strongly—only that the surfaces should bear evenly and moderately against each other, the crown of the ring being at the same time pressed against the forward face of the ring-recess.

A slot is cut upon the surface of each of the three closing-blanks on the plug; these slots run longitudinally down the center of the blanks on the forward (or engaging) part of the plug, but upon the locking-blank they turn, and run circumferentially at the same inclination as that of the breech-plug thread, and in a direction contrary to the turn of the plug while being locked into the screw-box. These slots are wide and deep enough to readily receive the lower ends of the guide-bolts, which project through the collar.

Near the closing-slot in the left blank is found a second and narrower slot, parallel to the longitudinal part of the large one, and running into the latter on the locking-blank. This smaller slot receives the heel of the latch, and at its forward end rises on an incline to the saddle, which will be further referred to in the description of the collar.

Around the rear end of the breech-plug a flange is raised, the forward side of which is finished with three locking-faces. (Plate II, 42.) These have the same pitch as those on the rear face of the collar. They match with those of the collar when the plug is thrust home, and while it is being turned to a bearing against the gas-check ring. These locking-faces (by their contact with those of the collar) prevent any jar being given to the lower ends of the guide-bolts when the plug is strongly shoved home in the breech, and direct the threads on the breech-plug to an easy engagement with those in the screw-box. This engagement is further facilitated by the chamfering of the right-hand ends of the threads on the breech-plug.

The plug is moved in and out of the screw-box by means of a bronze grasp-handle. On the upper end this gripe forms one with the lever used for locking the breech-mechanism.

The lever and handle dovetail deeply into the rear face of the plug-flange, and secured there by four stout screws which pass through lugs at the top and bottom of the grasp. Thus arranged, the lever is enabled to bear very considerable strain in the direction in which locking and unlocking is effected. The lever is also furnished with a handle at its upper end.

The Broadwell gas-check ring is made of copper, and fits into the ring-recess. (Plate I, 68.) The front of the ring bears against the forward face of the recess, and the face projects one-hundredth of an inch to the rear of the recess wall. The ring is cylindrical on its exterior, fits the recess neatly, and its face is furnished with two circular grooves, as is usual in this kind of check.

The forward side (or curve) of the ring is furnished with the usual expansion-groove and rib, and, as before remarked, the forward face of the nose-plate bears squarely against the face of the ring when the

breech-mechanism is locked. This check works very well indeed. The ring has a sufficient diameter to carry the inner edge of its flange back from the walls of the powder-chamber about one-tenth of an inch all around. This clearance is given to prevent injury to the ring during quick loading, and also to lessen the liability of the ring being dragged out of the recess by a sponge or while a shell is being withdrawn from the bore.

The plug, which has just been described, is the main feature of the breech apparatus, the other parts being merely appliances used to facilitate its working.

The principal of these appliances is the collar. (Plates I and II, 27.) This is a heavy ring, through which the breech-plug slides, by means of which it is turned away from the bore, and on which it rests when the breech is open.

The collar is strongly hinged to the right cheek of the gun, and is latched, when closed, to the left cheek. The latch is automatic in its action; it passes through a recess on the left side of the collar, and is so arranged that, besides holding the collar in place when closed, it prevents the plug from being pushed forward by any ordinary force, after the collar has been thrown back, (or open.) This is effected as follows:

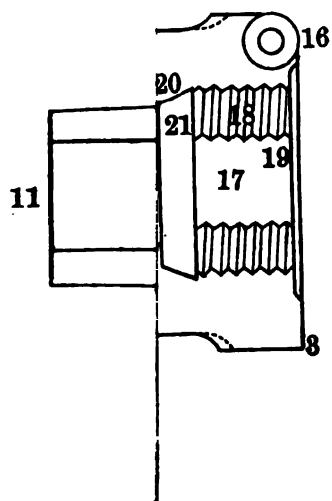
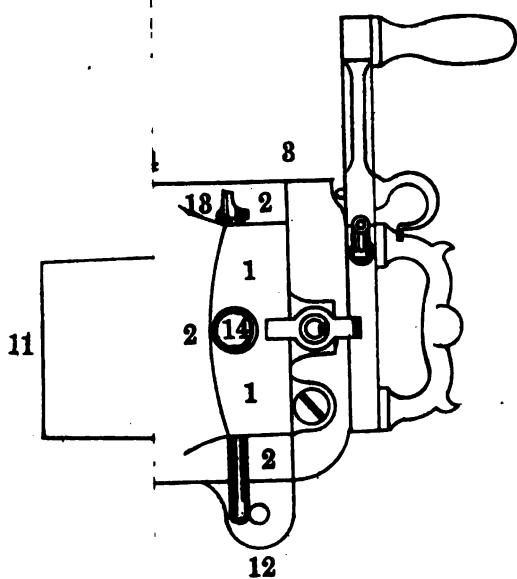
The heel of the latch-shank slides in its groove, and as the plug is being drawn out and approaches the end of its travel, this heel mounts an incline. The nose is thus liberated from its notch in the left cheek of the gun. As the plug is still drawn back, the heel of the latch is pushed down by its spiral spring into a saddle. The plug is now held steadily, as considerable force must be exerted in the direction of closing before the heel can be made to rise against its spring sufficiently to start out of the saddle.

It is necessary that the plug should be thus held, for in case of an attempt being made to close the collar when the plug is not drawn back as far as its travel will allow, the edge of its threads will strike upon and probably mar the rear threads in the screw-box, thus rendering the closing of the breech difficult.

Three masses are cast upon the round of the collar, and at equal distances from one another, around its periphery. Through them are screwed (radially) three stout bolts, called guide-bolts. (Plates I and II, 60.) The lower ends of these bolts are plain, and project about a quarter of an inch into the collar-bore, sinking nearly the same amount into the guide slot cut on the surface of the breech-plug. The guide-bolts limit the travel of the plug through the collar, and steady it generally during its working.

There is one more mass on the round of the collar; it is placed on the upper side, at one-sixth of the circumference to the right of the vertical plane, and is called the catch-mass. (Plate II, 33.) In the center of its after face it is pierced (in a line parallel to the axis of the bore) with a small hole to receive the heel of the catch-pin, which is borne on the lever of the plug. When the heel of the catch is engaged in this hole, it retains the lever of the plug in the locking position and prevents it from being turned back until the catch is raised by hand.

A circular portion of the forward face of the collar, lying immediately around its bore (or hole for receiving the breech-plug) is raised nearly a quarter of an inch above the general plane, and is connected therewith by an incline. This protuberance, (Plate I, 36,) which is called the guide, fits the corresponding guide-recess on the base of the breech of the gun. In case the collar-hinge should work loose, this arrangement is intended to guide the axis of the collar-bore into coincidence with that of the bore of the gun as the collar is closing.



ith that of the work of the gas in the com-

The bore of the collar is furnished on its surface with lands and grooves, three of each, (Plate II, 29, 30,) and their direction is parallel to an element of the bore of the gun. They are each nearly equal in breadth to one-sixth of the circumference of the bore, and match lands and grooves with the blanks and threaded sections of the breech-plug when the latter is in position to work longitudinally through the collar.

As the blanks of the plug slide upon the lands of the collar, the latter prevent the edges of the threads on the plug from catching the edges of those in the screw-box while the plug is being worked in or out. The lower ends of the radial guide-bolts enter the bore of the collar through the center of the lands.

At the after face of the collar the rear edges of the lands are inclined to the same pitch as that of the threads on the breech plug. These inclines are called the collar locking-faces, and are intended to match with the similar faces upon the flange of the plug after the latter is pushed home into the gun. When this contact is complete the threads of the plug and those of the screw-box are so situated with respect to each other that they will readily engage if the lever be turned to the right. (Note VI.)

### *Projectiles, &c.*

Shrapnel and shell are fired from these guns, the former weighing eight and the latter seven pounds, (loaded and fused.) The total length of the projectiles is two and one-half calibers. Their heads are ellipsoidal in shape and their cylindrical parts one and a half calibers in length. The walls of the shrapnel are three-tenths of an inch thick, and the chamber contains fifty-five leaden balls, caliber .52. The bursting-charge of two ounces of musket-powder is placed in an axial chamber running through the mass of bullets, which are retained in their places by sulphur. The shell is four-tenths of an inch thick, and presents the same general external appearance as the shrapnel. (Plate V, Figs. 1, 2, and 3.)

Each projectile is fitted with a copper rotation-belt (*r*, Fig. 2) about over the center of gravity. This belt has a length of *bearing* of two inches, and a taper toward the front of four-hundredths of an inch (all around) in the two inches, being an incline of one to fifty. The diameter of the forward bearing end of the belt is 2".92, and that of the rear end is 3"; this makes the squeeze on the belt in passing from the chamber into the bore just equal to the height of the rib in the gun.

The rotation-belt is furnished with grooves on its rear half only, as the squeeze on the forward half is but slight, and it is considered that the projectile requires firm bearing just forward of the center of gravity while on its passage through the bore.

About three-tenths of an inch from the base of the projectile there is fitted a steadying-ring, (*s*, Fig. 2.) It is one-quarter of an inch broad, semi-circular in section, and has a diameter of 2".98. Before the projectile is driven forward by the powder the steadying-ring does not bear against the walls of the chamber, but as soon as the bore proper is reached, the ring shows a squeeze of three-hundredths of an inch (all around) against the ribs, which thus hold the rear end of the projectile firmly and prevent it from battering or bruising the faces of the ribs, which, but for the presence of the ring, it would do as soon as the gun becomes a little worn. Both belt and ring are squeezed upon the body of the projectile in a screw-press. (Note VII.)

### *Fuzes.*

Fuses of several kinds have been designed during the course of experiments with these projectiles. One was a small percussion fuse hav-

ing the fulminate in a movable cap; another, a time-fuse with percussion igniter, the composition being sometimes disposed in a circle, and exposed by piercing, as in the service Bormann, and sometimes arranged in a vertical column and pierced through the side of the stock, as is the practice with the Boxer fuse.

The percussion fuse referred to seems to work well, and will usually explode the shell on contact with water when the elevation is over five degrees.

The time-fuses are satisfactory up to five seconds, but beyond that they have not as yet given very uniform results, though they show improvement as experiment goes on. (Note VIII.)

A very simple and ingenious rear fuse, (combined time and concussion,) the invention of Dr. William E. Woodbridge, has also been experimented with, and has given encouraging results.

The cartridges that will first be introduced are cylindrical serge bags, holding twelve and sixteen ounces of powder, respectively. The forward end of that now in use is closed by a thin wooden sabot, having a groove on its circumference, which takes a couple of turns of twine, thus securing the forward edge of the bag. (Note IX.)

The powder used is of rather coarse granulation. It was formerly known as "No. 7," and subsequently as rifle-powder. Ordinary cannon-powder has, however, been used in nearly all the experimental firing, and is well suited to the guns, but the coarser grain gives as good results, with less pressure.) Note X.)

#### NOMENCLATURE FOR 3-INCH BREECH-LOADING HOWITZER, STEEL FIELD-CARRIAGE

##### *Carriage.*

- |                                 |  |
|---------------------------------|--|
| 1. Cheek or bracket.            | 19. Trail-wheel loop-pin, (section.)                                       |
| 2. Wheels.                      | 20. Pintle-hook, with cap-square.  |
| 3. Axle, (tubular.)             | 21. Elevating-screw, (a disk.)   |
| 4. Brake-screw.                 | 22. Elevating-nut, consisting of nut and arms.                             |
| 5. Brake.                       | 23. Box-rest.  |
| 6. Axle-bearing.                | 24. Box trunnion-bearings.   |
| 7. Axle-clamp.                  | 25. Box axle-bearing and cap-square.                                       |
| 8. Trunnion-bearings.           | 26. Box-lugs.  |
| 9. Trunnion cap-squares.        | 27. Key-lug and key, (b, nose; c, shank; d, tail.)                         |
| 10. Breast-transom.             | 28. Box-rest, cheek-bolt.  |
| 11. After transom.              | 29. Linchpin, (head, shank, spring.)                                       |
| 12. Stay bolt.                  | 30. Washer and eye.  |
| 13. Trail-chock, (shoe.)        | 31. Wheel, felly, spoke, tire.)  |
| 14. Lunette.                    | 32. Hub, consisting of hub proper, (a, felly; b, lower b, and hub; bolts.) |
| 15. Elevator-bearing.           | 33. Wrench for carriage-bolts.   |
| 16. Trail-wheel.                |  |
| 17. Trail-wheel pin, (section.) |  |
| 18. Trail-wheel pin.            |  |

##### *Box.*

- |                    |  |
|--------------------|--|
| 34. Handles.       | 37. Clinch-hooks, (a, hook; b, pivot; c, clinch-plates.) |
| 35. Handle-straps. | 38. Lock.  |
| 36. Trunnions.     | 39. Compartments, (interior.)                            |

##### *Metallic cartridge.*

- |                           |                          |
|---------------------------|--------------------------|
| 40. Outer cup, with bead. | 45. Cylinder.            |
| 41. Inner cup.            | 46. Solder-seam.         |
| 42. Vent-disk.            | 47. Teeth.               |
| 43. Vent.                 | 48. Strengthening rivet. |
| 44. Ignition-holes.       |                          |







*Field-carriage.*

The field-carriage consists of a wrought-iron tubular axle attached to rail composed of two cheeks of quarter-inch sheet steel, placed vertically, and connected together by transoms.

The axle of the carriage for the light gun has an external diameter of six inches, the metal (wrought iron) being half an inch thick. The rails are solid, and are welded securely into the ends of the tube.

The axle is supported on wheels three feet in diameter. The felloes and spokes are made of oak, and the latter are inserted into a bronze hub. The wheels are kept in place by spring linchpins outside of bronze washers.

The different parts composing the trail are riveted together, the cheeks being deep enough at the forward end to raise the axis of the gun twelve inches above the center of the axle. There is a breast-transom joining the cheeks toward their forward ends. It extends diagonally from just in front of the trunnion-seats to the lower edges of the cheeks. The after-transom is placed just in rear of the elevating-screw, and stands vertically between the cheeks.

These transoms are of quarter-inch steel, and are flanged along each end to receive the rivets that join them to the cheeks.

Midway between the after transom and the shoe is placed a tie or stay-rod for the purpose of steadying the cheeks. A section of steam-pipe is fitted between the cheeks, and a piece of round-iron rod is put through the cheeks and the tube, and riveted outside the cheeks, thus binding them together. The upper edges of the trail-sheets, from the after transom to the shoe, are stiffened by angle steel riveted on.

At the point where the trail takes the ground when the trail-wheel is shipped, the cheeks are joined by a bronze shoe, which is flanged along on each side to receive rivets. It is also flattened and curved on the bottom, in order to form a convenient surface for sliding over the ground when recoil takes place. The side flanges of this shoe are joined by a diaphragm. The whole shoe forms a single casting.

After passing to the rear of the shoe, the trail-pieces are curved upward in the usual manner to receive the trail-wheel. This wheel is twelve, 12 inches in diameter. It is hung upon a "wheel-strap," which plays around a pin permanently inserted through the cheeks in the rear of the shoe. The trail-wheel, when shipped for moving the gun, runs upon its own pin, which is inserted through the cheeks of rail and through the hub of the wheel, raising the shoe about an inch from the ground. When the wheel is to be unshipped, preparatory to firing, the pin is withdrawn, and, the wheel being slightly raised, the shoe is again inserted through the cheeks and through a hole placed far enough from the center of the hub to raise the wheel sufficiently to clear it to go clear when the shoe of the trail is in contact with the ground.

Immediately in rear of the trail-wheel the cheeks terminate, being bolted together by means of a small wrought-iron chock welded between them. This chock has an eye upon its rear end.

The trail, as just described, is fitted to the tubular axle by bearings, bolted into the under edge of each cheek near its forward end, and secured to the axle-bearings at each end. The axle is prevented from sliding in these bearings by permanent keys, which are inserted into the axle, and fit into seats cut in the clamps.

The trunnions of the gun are supported in bronze trunnion-bearings

let into each cheek at the upper forward edge, and riveted in place. Capsquares are fitted to these bearings, secured with a hinge at the rear end, and an eye and forelock at the forward end. A bronze pintle-hook is secured to the axle between the cheek-bearings. It is intended to be used for hooking the trail of a second carriage (if desired) when on the march.

The exterior of the tubular axle has a thread cut on it at each shoulder. This thread is intended for the wheel-brake to work upon. The latter consists of a hollow bronze cylinder, or ring, with a short lever cast radially on its exterior. Half of the interior surface of the ring has a thread cut on it similar to that at the shoulder of the axle. The outer half is plain, and coned to fit the surface of the wheel-hub inside of the spokes. When this brake is in place on the threaded part of the axle, by turning the handle in one direction, the coned part can be made to approach and bind closely on the similar part of the hub inside of the spokes, and by reversing it can be drawn back clear of the hub. When set up by hand, the brakes confine the recoil to about 6 feet. After being once adjusted they are automatic in their action; tightening on recoil, and slacking when the carriage is run up to the firing position.

The rests for ammunition-boxes are of bronze, and are attached to the axle by capsquares at a point midway between the brakes and cheek-bearings. Each rest consists of a longitudinal strip of bronze, having a cross-piece at its forward end, and one also near its after end. The forward cross-piece has a lug at each extremity, forming a hook, into which the box-trunnions can slide from the rear. The rear cross-piece turns up at each end, forming lugs, or stops, to prevent the box from working off the frame laterally.

The lug at the rear end next the trail has an extension-piece running toward and touching the cheek; a hole is drilled through the cheek at this point, and a stout bolt is screwed from the inside of the cheek into a hole in the end of the extension-piece just mentioned. This device prevents the box-rest from turning upon the axle. The rear end of the longitudinal strip is turned up to form a lug, which keeps the box (when in place) from moving to the rear and disengaging its trunnions from the hooks. A key introduced through this rear lug fits into a hole in the rear handle-strap of the box, and prevents the latter from rising. This key can be drawn to the rear when its handle is turned upward, thus affording a ready means of removing the boxes when desired. The longitudinal and cross-strips of the box-rests are stiffened by ribs on the under side.

The ammunition-boxes are of pine, and each holds ten rounds. The projectiles are stowed (between vertical cleats) in two parallel rows, the upper ends being steadied in cleats nailed to the inside of the covers. The cartridges stow between the two rows of projectiles.

The box-handles are of bronze, and triangular in shape; they are secured to the boxes by bronze straps. The lower end of each strap turns under the bottom of the box and is there secured. The after handle strap is enlarged near the lower part, and has worked in it a hole to receive the key, which is inserted through the after lug of the box-rest.

Clinch-hooks are used for keeping down the covers; they are of bronze, and so arranged that the hook binds most strongly against the rib on the clinch-plate at a point somewhat short of the position at which it is intended that the hook shall rest when the lid is fastened down. It will be difficult for the apparatus to unhook accidentally, as the hook meets increasing resistance for some time after first contact.





turned back. One of these hooks is placed on each end of the box, the clinch-plates being secured to the corresponding ends of the lid.

The box-trunnions are of bronze, and are secured by screws to the sides of the box near its lower edge, and about a quarter of the length of the box from its forward end. The lower edge of the trunnion is in the same plane as the bottom of the box. These boxes are shipped and unshipped from the rear.

#### DISSEMBARKING AND EMBARKING.

The howitzer is intended to be disembarked from the boat and embarked separate from its carriage. This plan offers several advantages, the principal of which are avoidance of the difficult operations of mounting the gun on its field-carriage while in the bow of the boat, and of guiding the gun on its carriage down the inclined landing-skids.

On reaching the landing-place, the capsquares are thrown back, and elevating-pin pulled out. A spar some twelve or fourteen feet in length (say the boat's mast) is laid longitudinally on top of the gun, which is attached to the spar just forward of the trunnions by a grommet slipped over the chase, and just abaft the trunnions by a couple of turns of a soft lashing. Thus slung, the gun hangs nearly balanced and very steadily.

Four of the higher gun numbers then jump over the bows, two of them placing their shoulders under the forward end of the spar, while the remaining two stand by to take the heel of the spar after the gun has been lifted from its trunnion-seats and has passed over the bows, and ahead of their position. The men in the water at the forward end of the spar, and some of the boat's crew at the after end, then raise the spar, and with it the gun, which passes out of the boat over the bows, and is carried ashore by the numbers and in the manner mentioned above. It is then placed on its field-carriage.

It is thought that on most occasions, in actual service, (at least in the case of the light gun,) the tracks in the boat and also the landing-skids can be dispensed with. The field-carriage, without its ammunition-boxes, could be put overboard without difficulty from the boat's quarter, and run up by drag-rope on the beach.

To embark this carriage, the boat lying with her stern to the beach, run the carriage into the water, axle toward the boat. Two men outside of each wheel, grasping the fellies at the lowest part, raise the carriage up until the axle can be seized by the men on the taffrail. The men in the water then grasp the trail and push upward toward those in the boat. The axle once inside the taffrail, the trail is easily gotten over, and the carriage can be placed in its proper position.

#### BOAT-CARRIAGE.

The boat carriage is composed of bronze, wrought-iron, and steel. The top of the slide consists of two flat rails of wrought-iron, united at the forward ends (by welds and rivets) to a wrought-iron transom. This transom is riveted to the pivot-plate or jaws. At the rear end the rails are united by a bronze casting or transom, which extends from one to the other, and affords a bearing for the India-rubber pads forming the bumpers. The ends of this transom are bolted through the extreme rear ends of the rails by strong nut-bolts. The rails are supported by cheeks, about six inches deep, made of quarter-inch steel, flanged at the upper and lower edges.

The upper flanges serve for riveting the cheeks to the rails, the heads of the rivets being countersunk on the upper side. The lower flanges

form the feet or base on which the slide rests and traverses. Near the lower part of the cheeks, at each end, there is a tie-bolt within a wrought-iron tube, the ends of the tie-bolt pass through the cheeks and are riveted over, thus forming stay-bolts, which stiffen the structure, and prevent the cheeks from spreading at the lower part.

The rails are planed on their upper and under sides, and have a thickness of one-hundredth of an inch more at the rear than at the front ends. This gives increasing squeeze to the compressor as it travels to the rear.

The top carriage is made of bronze, and is cast in one piece; the part which slides upon the rails taking the form of transoms, that which supports the trunnions of the gun being formed into four legs, two nearly vertical, the other extending from the trunnion-bearings nearly to the rear end of the top carriage. The forward legs are joined together by a transom about half-way up toward the gun, and all are strengthened by ribs.

The compressor is of the frictional form. On the under side of the forward transom of the carriage are cast four masses or projections, two just forward of the place for the compressor-plate and two just abaft it. These are intended as guides to force the compressor-plate to follow the movements of the carriage; they also prevent the carriage from working laterally upon the slide.

The compressor-plate is a rectangular flat piece of bronze, heavily ribbed on the under side. The rib expands into a boss in the center of the rectangle, and through this a hole is drilled, (perpendicular to the plane of the face,) which receives the compressor-screw. The long axis of the compressor-plate stands across the general direction of the rails, and it is recessed on its upper side toward the ends for the extent of its bearing on the under sides of the rails. Pieces of lignum-vitæ are let into these recesses, and form the frictional surface which bears against the slide, giving the range of elasticity which is necessary to such compressors. Elasticity is also to a certain extent obtained by the spring of the compressor-plate, owing to the distance of the point of frictional bearing from that of application of the power.

The compressor-screw being shipped through the plate from below upward, and its head engaged in the recess, (to prevent turning,) the plate is placed under the slide, and the bolt is pushed up through the hole in the forward transom of the carriage. When in position, the compressor-screw projects some distance above the transom of the carriage, and the lignum-vitæ pieces on the ends of the compressor-plate bear against the under sides of the rails of the slide. A strong nut is then screwed on the upper end of the compressor-screw, and run down until it bears against the boss on the upper side of the carriage-transom. A lever is now shipped on this nut, and by applying power the compressor is made to bind firmly against the under side of the slide, the action of the nut forcing the carriage down on top, thus squeezing the rails between the two surfaces.

The compressor-plate also acts as a "clip," and prevents the forward end of the carriage from rising off the slide when the gun is fired. The rear end of the carriage is kept down by projections on the ends of the elevating-screw trunnion-bearings.

The compressor is simple and efficient; it can be easily made automatic in its action (as regards tightening when the gun is fired) by putting a little lead (or other weight) into the end of the lever. The twist of the compressor-screw is such that the inertia of the lever will cause the screw to "take up" when the carriage is jerked back as the

gun is fired. In the course of experimental practice at Washington navy-yard, the lever is usually turned up to a slight bearing before firing the gun. The play of the lever when thrown back is limited by the after leg of the carriage.

As the elevating-screw is attached at its upper end to the gun, it must be at liberty to oscillate on the carriage, and for that purpose it works through a nut which is hung on trunnions near the after end of the carriage. The elevator is a double screw, and is moved by means of a broad hand-disk.

The usual recoil of the light gun on this carriage is from ten to fifteen inches. There is an attachment for adapting the carriage to use with the heavier gun, which, mounted on it, shows a recoil slightly greater.

The pivot-plate for the bow of the boat has but a single eye, the double eye being on the carriage. Above and below the eye the plate is pierced for one-and-a-quarter-inch bolts, which pass through the stem of the boat, and are fitted with good, deep nuts outboard. The stern-plate will also be fitted with two bolts. These plates are purposely made with a large margin of strength.

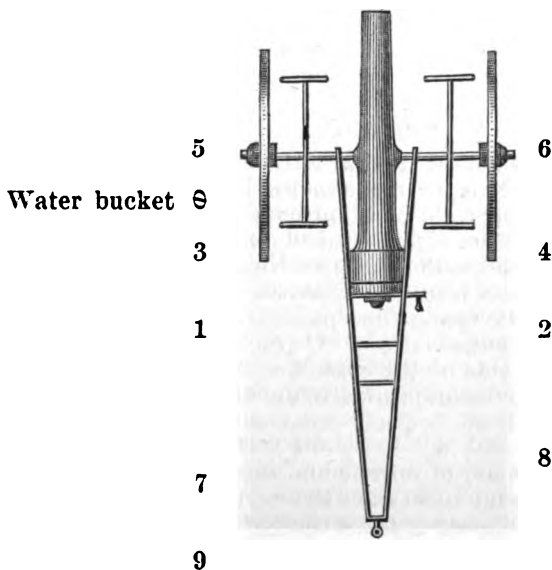
When the gun is mounted, the top carriage is readily moved in and out by hand.

MANUAL OF DRILL FOR 3-IN. B. L. HOWITZER ON FIELD-CARRIAGE, CREW OF 12 MEN.

- No. 1. Captain of howitzer.  
2. Second captain of howitzer.  
3. First sponger and loader.  
4. Second sponger and loader.

- No. 5. Left wheelman.  
6. Right wheelman.  
8. Trailman.  
Nos. 7 and 9. Ammunition men.  
10, 11, 12, and quarter-gunner, in rear.

*Station of crew of gun "in battery."*



Boxes 20 paces in the rear.

Q. G.  
10, 11, 12.

*Duties.*

No. 1 superintends—gives orders in absence of an officer. Places himself on the left and rear of gun just outside of the line of the wheel.

No. 2 provides himself with haversack containing boring-bit, nipple-wrench, lanyard, and friction-primers. Places himself on right side of gun opposite No. 1.

No. 3 provides himself with staff-sponge, which he will wet in water-bucket, and never allow the sponge-head to touch the ground. Places himself on left of gun abreast of breech and directly in front of No. 1.

No. 4 receives wet hand (or marine) sponge from No. 5. Places himself on right side of gun opposite No. 3.

No. 5 provides marine sponge and water-bucket, which he will place outside of and between himself and No. 3. Wets marine sponge and hands it to No. 4. Sets up wheel-brake and then places himself outside of left wheel in line with the axle and directly in front of No. 3.

No. 6 sets up wheel-brake and places himself on the right side of the gun opposite No. 5.

No. 7 collects ammunition-pouches from Nos. 3, 4, 5, and 6, (see note, and carries them to the rear. Places himself two yards in rear and left of the trail. He will alternate with No. 9 in supplying the gun with ammunition.

No. 8 unbolts the trail-wheel and secures it against the recoil, unhooks drag-rope, carries it to the rear and coils it near the ammunition-boxes, then places himself to the right and abreast of the trail-wheel in line with the numbers in front.

No. 9, assisted by No. 11, will carry the left ammunition-box to the rear, then take station two yards in rear of No. 7.

No. 10, assisted by No. 12, will carry the right ammunition-box to the rear, then falls in line in rear of ammunition-boxes under cover if directed.

Quarter-gunner carries spare-article box and short drag-rope to the rear. Has general supervision of all articles in rear of the gun.

Nos. 11 and 12 fall in line in rear of ammunition, under cover if directed.

*"Sponge."*

No. 4 steps to the right side of the breech, seizes the gripe of the plug with the left hand, the forefinger through the loop of the catch, draws the catch back, and with the right hand throws the lever sharply upward until it becomes vertical, then with the left hand draws the plug smartly to the rear, which will release the collar and open the breech; he then inspects the plug screw and nose and wipes them off. He will wipe out the recess after the bristle sponge has passed through, taking care to remove all dirt from the recess.

No. 3 steps to the left side of the breech, and as soon as the breech is open passes the sponge-handle through the bore, sponge-head to the rear, until the rammer-head projects from the muzzle, then receives shell from Nos. 7 or 9.

No. 5 places himself at left of muzzle and seizes sponge-staff as soon as possible, draws it through until the mark on the handle is at the face of the muzzle, then turns it two or three times, (for the purpose of cleaning the powder and shot chambers,) and draws it through the bore, dips sponge-head carefully in the bucket, and passes the sponge to No. 3 as soon as that number has resumed his position outside of the line of recoil. If the marine sponge requires wetting, No. 4 hands it to No. 5, who wets it and returns it.



*"Load."*

No. 3 enters the projectile and pushes it smartly home with the right hand, then receives the cartridge from the passer and places it in the chamber, falls back out of line of the recoil and receives sponge from No. 5.

No. 4 closes breech. With the left hand pushes the plug smartly forward and with right hand throws the lever down to its place. He then attends the elevating-screw.

No. 2 while the gun is being loaded hooks a primer to the lanyard and prepares to fire the piece.

*"Point."*

No. 1 adjusts sight-bar and falls back to end of trail in line of sight.

No. 4 tends elevating-screw.

No. 8 assists No. 1 in training the gun when it is necessary.

No. 2 has a primer hooked to lanyard and held in his left hand, bights of the lanyard in his right.

*"Ready."*

All numbers fall back outside of line of the recoil except No. 2, who steps forward and inserts primer in nipple, then falls back clear of the wheel to end of lanyard, holding it in his right hand.

*"Fire."*

No. 2 pulls lanyard.

Nos. 5 and 6 run gun up into position.

*"Secure."*

All numbers will secure what they have cast loose at the order "In Battery," (Nos. 5 and 6 being particular to release the wheel-brakes before the ammunition-boxes are placed on the rests,) then man the drag-ropes.

*Note.*—The rounds from the boxes of these numbers are to be used first.

All movements of the breech must be made smartly, otherwise the mechanism does not work smoothly.

The wheel-brakes should be set up but moderately as they tighten on recoil. They do not require slacking when the gun is run up to battery, but adjust themselves. The brakes cannot be released after the ammunition-boxes are on the rests; therefore, at the order "Secure," relieving them is the first thing to be attended to.

When the gun is mounted on the boat-carriage the numbers as high as 6, inclusive, have corresponding duties to those laid down for shore services, as far as the manipulation of the gun itself is concerned, with the following exceptions:

The gun is fired (as well as pointed) by No. 1.

No. 2 inserts the primer into the nipple at the order "Point," hands the toggle of the lanyard to No. 1, and then assists in training.

As regards the carriage, No. 5 attends the pivot-bolt; No. 6, the compressor.

All the numbers abreast the gun assist to run in and out.

*Precautions.*

If the breech is difficult to open, strike a few blows with the rammer head, or a mallet, on a wooden setter held against the lever below the handle.

If it is closed with difficulty, see that the cartridge bag has not been caught, or the shot not home. Sponge off the plug with a dripping sponge; water is the best lubricator in firing. A soft cloth, which does not ravel, is quite as good as a marine sponge.

If the shell does not go home readily give it one or two smart taps with the rammer-head. See that the shell has no sand or dirt on it.

*Miss-fire.*

Examine the exterior vent, and if choked clear it with the plyers. Then try a second primer. Do not open the breech until certain there is not a hang-fire; then examine the vent-check and see that it is loose.

*Cease firing.*

As a rule the piece should be discharged, or the load drawn. As both time and percussion fuses have fulminate igniters, the shell or shrapnel should be pushed out, not struck a hard blow.

*On shore.*

It will be observed that there is a pintle-hook (20) on the axle for the lunette, by which two carriages can be coupled and thus ease the draught.

There will then be a great temptation to utilize the carriage for transportation of extra ammunition, intrenching tools, or provisions. The officer should have strength of mind to resist this, since the carriages are made as light as consistent with proper strength for the service for which they were designed; if over-weighted they would be over-strained.

## CLEANING 3-IN. B. L. HOWITZERS.

*Bore and chamber.*

Remove the elevating-screw, open the breech-mechanism, raise the breech, and wash out the bore and chamber with a wet woollen sponge, entered at the breech. If very dirty, use a weak solution of potash or soap-suds.

*Breech-mechanism.*

Wash with a wet marine sponge the plug and its recess. If this will not remove dirt and gum, use the bristle-brush and pointed stick to clean out the screw-threads and corners, push the plug in and out the collar and turn it so as to get at all parts. Dry them well with a clean rag, also the bore and chamber, using the pointed stick and rag to thoroughly dry all recesses. If any of the iron or steel parts are slightly rusted, clean them with an oiled stick. The breech should be left open until all parts are thoroughly dry, and, as a rule, kept open.

*Oiling.*

Have a soft brush and woollen rags, kept only for this purpose, and best machinery-oil. If the oil is thick it should be filtered. Oil the bore and chamber with a linen rag slightly oiled, wrapped round a sponge-head.

Pass the oiled brush very slightly over all parts of the mechanism; with a feather oil the hinges and interior of the collar and the guides and slots of the plug. Run the elevating-screw up and down, and slightly oil the iron threads.

If by gross negligence the breech-plug or other steel parts should become much rusted, the armorer, who is required to be a skillful mechanic, should be employed to dismount and clean it, under the supervision of an officer.

#### *Cleaning implements.*

The only materials to be employed are marine sponges, woolen and cotton rags, pointed sticks of soft wood, small bristle-brushes, long and short sponges for bore and chamber. The use of files, scrapers, emery, and bath-bricks is absolutely forbidden. In dismounting the parts, wooden mallets, hard-wood setters, and the proper wrenches shall be used.

#### *Firing.*

Before firing all oil should be wiped off the plug, and after each round the plug, nose-plate, and breech-recess should be sponged with a wet marine sponge. The mechanism will then always work freely.

In the intervals of firing, if the piece is at rest, the breech should be left open. Tompions should never be used, as neglect to remove them may cause very serious accidents. If necessary, muzzle-bags should be fitted.

The breech-mechanism should be removed at sea.

#### NOTE BY THE CHIEF OF BUREAU.

In 1873 Captain Sebert, Artillerie de la Marine, says, speaking of heavy guns 14 to 42 cm.:

Du puis que cette artillerie a été placée entre les mains de nos marins et de nos artilleurs, grâce aux règles prudentes et sûrement vérifiées auxquelles elle a été assujettie, *pas un seul accident de rupture* n'est survenu; et cependant il a été fait des tirs d'exercice, à petite et à grande charge, en nombre considérable, lesquels, entre autres sur le vaisseau-école des matelots canonniers, se comptent par 50 et 60,000. Aucune nation ne peut proclamer un pareil résultat.

Il faut d'ailleurs bien se garder de confondre, confusion dont on a parfois abusé, les résultats du *service régulier* avec ceux du polygone de Gavre, où des résistances à des maximum d'efforts sont expérimentées et les règles d'emploi sont déterminées.

C'est là qu'en faisant éclater des canons à des limites extrêmes, on apprend à ne pas les faire éclater dans leur tir normal.

#### NOTES.

NOTE I.—*Casting and stretching.*—Chilling bronze increases its density, raises its elastic limit considerably, its tensile limit somewhat, and diminishes its extensibility. This metal has, however, a surplus of the latter quality, and can afford to lose some.

The absolute amount of change of quality experienced by chilled ingots seems to vary somewhat with the mass of the metal at different points in the mold, even where the thickness of the mold is kept proportional to the diameter of its ingot at each point; and this fact was soon demonstrated by the discovery that the chase and muzzle parts of the short howitzer ingot could not bear nearly as much expansion (from mandreling) as the large or breech parts.

Cracks appeared on the crust or outer surface at the points mentioned, and threatened to penetrate to the lines of the finished gun. These cracks usually appeared from the muzzle to just abaft the trunnions; and at the same time it was noticed that the breech parts were not hardened by the action of the chill as much as was desirable.

It thus became necessary to lessen the chill on the muzzle parts and to increase it on the breech, which was accomplished by extending the chill-mold some inches beyond the lines of the finished gun at each end.

By this means the molten bronze below the finished muzzle-lines retard the chill in

that vicinity; and the substitution of chilled bronze above the breech for the hot-sinking head in sand-walls which had at first occupied that position, increased the chill at the breech end of the gun.

The qualities of the ingot were thus rendered more uniform throughout, though this could be more readily done in a future case by increasing or diminishing the thickness of the walls of the chill-mold itself.

The principal object in view in endeavoring to harmonize the qualities of the metal throughout the ingot, was to secure an expanded bore of uniform diameter. The amount of "spring-back" of the walls of the bore after the passage of the mandrel depending at each point on the amount of chill which the metal about that point had previously experienced, the elasticity exhibited by bronze being roughly proportional to the amount of chill.

It will be readily seen that the exterior of the gun would better support the interior parts against the effort of the charge if the outside metal of the ingot could be left to become part of the finished gun. This is, however, not practicable, because this layer, being much chilled and having but little extensibility, is generally more or less cracked by the stretch it has to sustain in the mandreling process. Besides, it is generally full of fissures and bubbles, and about a quarter of an inch all around should be taken off before close and uniform metal is reached.

The irregularities on the exterior of the ingots increase as the interior of the chill-mold becomes cracked with use, the cracks retain air, which expands when the molten metal fills the mold, and thus forms "blows" and bubbles. This has not, however, (within the limited experience already had,) been known to render a chill-mold unfit for use. The interior of the ingot always presents metal of a remarkably close and fine appearance, free from fissures or bubbles.

As the sinking head is the last part of the ingot to cool, it will be observed that the "shrinkage" of the mass takes place *upward*. The lines of the ingot admit of such motion readily at all points, excepting at the trunnions; consequently, the upper sections of the trunnion-molds require to be made movable, in order to allow the trunnions to rise with the rest of the ingot. These sections are moved outward as soon as the casting has stiffened, (about a minute after the mold is full.)

The passage of mandrels through the bore enlarges it, and presses back the concentric layers of metal progressively from the bore toward the exterior of the ingot, those next the mandrel, of course, sustaining the most expansion. The last mandrel must have a diameter about two hundredths of an inch greater than that of the finished bore is intended to be, because the remaining elasticity of the metal composing the ingot causes the walls of the bore to spring back somewhat, as soon as the greatest diameter of each mandrel has passed any given point. After the walls of the bore have stretched from 7 to 10 per cent., the amount of this resilience is about two hundredths of an inch in terms of the diameter.

By the passage of the ten mandrels, the diameter of the bore is increased three-tenths of an inch, while that of the exterior of the ingot increases about one-tenth of an inch at the muzzle and five hundredths of an inch at the breech.

It is not found that any condensation of the metal has taken place, the volume and specific gravity remaining appreciably the same after as before the operation. The surface of the bore is, however, greatly hardened by the process, and a thin "test-specimen" taken from its walls, shows an elasticity, tensile strength, and hardness about equal to that of soft steel.

The hardening diminishes rapidly as we proceed from the bore toward the exterior of the ingot, and at a distance of only one-half an inch from the surface of the bore the qualities of the bronze do not appear to have been greatly altered by the mandreling. The important point gained is, however, the surface-hardening, enabling it to bear without too great wear the friction of the copper belts on the projectile.

In shape, the mandrels resemble two short cylinders, joined by a cone. They are made of hard-tempered steel, and so great is the friction attending the process that they wear quite rapidly, appearing to become honey-combed. They are pulled through the bore by means of a hydraulic pump, which is required to exert an effort of about 130,000 pounds.

The arrangement by which the mandrels are attached to the pump is temporary in its character. It would doubtless be more advantageous to push instead of pulling, but the Ordnance Department does not possess a powerful pump, and is compelled to borrow.

After the mandreling is finished, the ingot is found to be somewhat shorter than before the operation; the circumferential stretch of the metal, particularly about the chase, having apparently resulted in a call upon the ingot to give up somewhat of its length. The shortening takes place principally between the trunnions and the muzzle, and amounts in all to about seventeen hundredths of an inch, of which fourteen hundredths occurs forward of the trunnions. These figures have reference to the light gun when the bore is expanded seven per cent.

After the ingot comes from the hydraulic pump, the bore is tested for straightness.

and it is often found bent, usually in the chase, and only a few hundredths of an inch. It is straightened by very careful blows under a steam-hammer. The bending is probably owing to differences in the quality of the metal on opposite sides of the bore rather than to the imperfection of the appliances used in mandreling.

*Table showing the mechanical effects of chilling and mandreling upon bronze three-inch howitzers.*

Foundry letter of gun.	How cast.	Part of gun from which specimen was taken.	Elastic limit—pounds per square inch of original area.	Tensile limit—pounds per square inch of original area.	Percentage of elongation, measured after fracture.	Specific gravity.	Hardness.
F & G.	In sand molds .....	Muzzle.	15,700	45000	51	8.590	.....
I.	In chilled mold .....	do ..	19,000	50000	25	8.875	.....
O.	Chilled and mandreled .....	do ..	35,000	*48000	94		10.332
Piece of mild steel taken from a gun-ingot furnished by the Nashua Steel Works, New Hampshire.							
							338

\* The tensile limit of ingot O was probably inferior originally to that of ingot I.

† Specimen taken from the skin of the mandreled bore.

This method of hardening bronze, which has been adopted in Austria under the name of "steel-bronze," is due to Mr. S. B. Dean, of Boston, who patented it in 1869, several years before General Uchatius's experiments.

NOTE II.—*Profile of threads.*—The French have made a long series of experiments upon the form of breech-closing apparatus under consideration; it was first introduced to their notice by the inventor, (an American,) and was adopted into their naval service.

It has stood the test of actual war, and was used in the heavy naval guns which were placed on the defenses of Paris during the German siege.

All the French naval guns have this form, and numerous experiments were of course made as to the proper pitch and profile of breech screw. A profile similar to that used in our howitzers was finally decided on as being best adapted to resist the thrust of the charge without injury.

In bronze guns it becomes particularly necessary to select a suitable profile for the thread, owing to the ductility of the metal. Should the bearing-face of the thread be made too steep, (or perpendicular,) there will be a probability of serious distortion of the thread under pressure. On the contrary, if the profile be slight, and if the angle formed at the apex of the thread be too obtuse the plug will have a tendency to "wedge up" on the bearing-faces of the threads of the screw-box, and will, as a result, stick after fire, requiring the expenditure of considerable force on the lever before the breech can be unlocked.

An examination of the faces of the breech-thread, as arranged in the howitzers, will show that a large part of the force exerted to thrust back the plug is thrown toward the base of the threads, and yet the inclination is not sufficient to cause any wedging of the threads of the plug upon those of the screw-box. (See Note V.)

NOTE III.—*Vent-check.*—The vent-check has to sustain considerable shocks in both directions. The primer gas strikes a much stronger blow than would generally be supposed, and of course the pressure of gas arising from the inflamed charge is very great.

The first forms of vent-disk were made of thin, hard steel, and several cracked during practice. They are now made of mild steel, about one-tenth of an inch thick, and have stood very well.

NOTE IV.—*Vent.*—In experimental practice at the navy-yard, Washington, the vents of the howitzers have never become obstructed, excepting on two or three occasions, and then owing to the bursting of the metallic friction-primer tube in the upper end of the vent. To clear this of course does not require any backing of the offset cylinder, but the use of the pliers might become necessary to withdraw the expanded primer-tube.

It is, however, probable that a quill friction-primer will be issued with the guns, in which case of course there will be no obstruction.

If it should, however, at any time become necessary to clear the vent, back the offset cylinder, and insert the boring-bit into the main vent.

NOTE V.—*Lining, &c.*—It is probable that the amount of lining forward required in service will be very trifling.

During the proof-firing of a new gun the plug will always be set back somewhat, as

the thrust of a few rounds is required to bring the bearing-faces of the screw-threads uniformly and closely into contact, but chiefly to give the threads themselves that "permanent set" or slight alteration of profile, beyond which they will not afterward go. This "set" can of course be detected only toward the apex of the thread, and by the application of the "template" after the proof-firing.

In a 500-lb. hardened bronze gun, after seventeen rounds, using 16 ounces of ordinary cannon-powder, the apex of the thread was found to be set to the rear 0".012. It is probable that this displacement was accomplished in the first two or three rounds.

The threads of the plug showed the same amount of distortion, and as the whole set-back of the plug only amounted to 0".025, it will be seen that the original correspondence of the threads as regard pitch and profile must have been very exact.

It is unlikely that any additional set-back will occur in service, but still it has been considered necessary to provide for such a contingency in the construction of the plug which otherwise could not be considered as complete. For that reason the nose-plate has been made movable, as described in the text, and "liners" of proper thickness will be supplied.

In order to show how strong the breech-mechanism is against the effort of the charge, it may be permitted to refer to a very exceptionally weak gun, which in experimental firing at the navy-yard, Washington, exhibited excellent endurance.

In this gun the thread in the screw-box had been turned out, and (the diameter of the box being somewhat enlarged, and a fine thread cut on its surface) a "sleeve" was screwed in tightly.

A breech-plug thread of the regular profile and pitch was then cut upon the interior surface of the sleeve, the blanks being afterward cut as usual.

The thickness of solid metal in this sleeve was only a quarter of an inch, and the number of turns of thread in the screw-box was three-fourths of the number used in the service-gun.

Notwithstanding the evident weakness of this sleeve, and the number of turns of breech-thread, the plug was found set to the rear only eleven hundredths of an inch after eighty-four rounds with service-projectiles and cannon-powder of very high initial velocity.

The most of this displacement was due to "flow" of the molecules of the thin layer of metal included between the bottoms of the threads in the sleeve.

This construction labored under another very serious disadvantage: the breech-plug was made of hard steel, the threads upon which, not yielding in the least to the effort of the charge, threw all the change of form upon the weak sleeve and threads of the screw-box.

Had the sleeve been of double its actual thickness, no doubt the "set-back" shown by its threads would not have exceeded five hundredths of an inch, and the gun, even as it is, can still be used for experimental work.

As before remarked, the extensibility of the bronze of which these plugs and guns are made (upward of thirty per cent.) would admit of a large amount of distortion of the thread before fracture could take place. It is, however, not advisable to allow the nose-plate to recede from the Broadwell ring, because in such a case the latter is also set back, and if made of copper is liable to be deformed after a few rounds, if allowed much play. It will continue to check gas well, even after considerable distortion, but is of course eventually rendered useless.

Though the plugs in each class of gun are manufactured to be interchangeable, it will be best in practice, as far as possible, to keep each plug in the gun to the screw-box of which it has become matched by the proof-firing. On this account plugs should be numbered the same as the guns with which they are proved.

NOTE VI.—*Travel of the plug through the collar.*—In its travel through the collar, the lower part of the two lower blanks on the plug rests upon the corresponding parts of the lower collar-lands.

The lower ends of the guide-bolts do not quite reach the bottom of their slots, and the bolts have a play in the slots (sidewise) of about .025 inch each way. If the plug be turned or shaken circumferentially, the ends of the threads will bring up against the sides of the collar-lands, and are thereby prevented from touching the ends of the threads in the screw-box, as the collar-lands are slightly broader than the corresponding threaded sections of the screw-box.

NOTE VII.—*Belt and guide-ring.*—Both the rotation-belt and guide-ring must be firmly attached to the projectile, in order to communicate rotation to the latter without any "slip."

On the exterior of the cylinder of the projectile, and about over its center of gravity, a broad groove or recess is cut  $\frac{3}{8}$  of an inch in depth, and as long as the rotation-belt (which it is to receive.) At  $\frac{1}{4}$  of an inch from the base of the projectile another groove is cut, of similar depth and a quarter of an inch wide; this is to receive the "guide-ring."

A cold-chisel is then used to nick the bottoms of these grooves all around, at inter-

vals of about  $\frac{1}{4}$  an inch; the direction of the chisel-marks being lengthwise of the projectile, and their depth about two or three hundredths of an inch.

Cylindrical rings of copper are cast in sand molds, and of length suitable for making rotation-belts and guide-rings. The interior diameter of these rings is very slightly greater than that of the cylindrical part of the projectile. The thickness of the metal is  $\frac{1}{16}$  of an inch.

The rings are then slipped over the projectiles and squeezed, (or permanently compressed,) by a screw-press, into the grooves prepared for them. This operation not only fills the grooves completely and makes the rings hug the body of the projectile, but also forces the copper slightly into the marks left by the cold-chisel at the bottom of the grooves; thus powerfully assisting to prevent any possibility of the belt slipping circumferentially upon the projectile. The projectiles, with their rough belts and rings on them, are then centered in the lathe, and the bearings are carefully turned down to the diameters and profiles given on the drawings.

The experimental projectiles have been all turned on the exterior, and it is probable that this practice will obtain with service projectiles, at least as far as the cylindrical part is concerned. The windage in the bore being small, ( $\frac{1}{32}$  of an inch all around,) it is of course necessary to have the body of the projectile "true," and accuracy of flight is also promoted thereby.

After the projectiles are finished, they are inserted into a sort of cylinder-gauge, which has on its interior a compression-slope exactly like that in the chamber of the gun. This gauge is cut of such a length that if the rotation-belt has been correctly made and placed, the base of the projectile will just come even with the top of the gauge.

It must be observed that the grip of the rotation-belt on the projectile is very much increased when the gun is fired, as the squeeze due to driving the shot through the compression-slope of the gun powerfully assists to bind the belt firmly to the projectile. Experiment shows that this pressure is much greater than that received by the belts from the screw-press; a belt has never yet been known to slip upon a projectile when fired through the gun.

The central rotation-belt, when squeezed in the compression-slope, has the merit of supporting the walls of the projectile at its weakest point against the upsetting effort of the powder-gas.

The diameter of the bore in these guns being large when compared with the weight of the projectile, the walls of the shrapnel are made only three-tenths of an inch thick, in order to admit of a sufficient number of balls being used without increasing weight too much. Were it not for the support derived by the middle parts of the projectile from the squeezing of the belt against the walls of the bore, the pressure of the powder-gas against the base, when the shot is driven into the compression-slope, would often cause the walls of the cylinder to swell out and burst, sending the projectile from the gun in a shower of pieces.

This has often happened in the course of experimental work, where non-supporting forms of belt were used with thin and heavy projectiles. When recovered from the butt, the pieces that formed the cylinder toward its middle part show upon their exterior distinct impressions of the ribs of the gun, making evident the fact that the projectiles were swelled outward and pressed against the walls of the bore.

In the form under consideration, it is thought that the tendency to swell out and burst along the parts of the cylinder in rear of the rotation-belt is repressed by the pressure of the powder-gas, which is freely admitted to those parts of the projectile in rear of the belt. One of the reasons for keeping the guide-ring less in diameter than the chamber into which it is loaded is to afford free and instant passage for this supporting gas to the after part of the cylinder of the projectile.

As the inclination of the compression-slope is very small, (one in fifty,) a slight amount of residuum upon the ribs of the gun at that point will suffice to set the projectile back in the bore a considerable distance; and as it may be desired to fire the gun a number of rounds, at critical moments, without cleaning the chamber, it becomes important to know how far forward of the cartridge the shot must stand when the gun is clean, in order to allow space enough for "set-back" on fouling of the bore from omission of sponging.

Experiment with the heavy gun showed that when the sponge is not being used the position that the projectile will occupy in the chamber varies from one round to another between one-tenth and four-tenths of an inch. After the third round the set-back of the projectile did not increase beyond four-tenths, and about three-tenths could be taken as the average.

The light gun, having a less amount of powder in the charge, shows rather less fouling than the heavier gun; and when a metallic cartridge is used, the residuum left in the chamber of each class is somewhat less than that shown when using the serge bag.

When bronze howitzers are first issued for service they will show a less interval between cartridge and projectile than that referred to above. If after some service the slopes do not seem to show much wear, the chambers will be reamed deeper.

NOTE VIII.—*Fuses*.—Quite a number of fuses have been experimented with in connection with these howitzers.

The first form was a small percussion fuse, having a plunger in the interior of the stock, somewhat like that used in a Schenkl fuse; but the nipple on the head of the plunger was not furnished with a percussion cap like those of the fuses just mentioned. A hole was pierced from the nipple through the axis of the plunger; this hole was filled with grained powder. (Plate V, Fig. 1.)

Into the upper part of the stock was screwed a bronze cap which contained fulminate in a shallow recess out upon its under face.

The plunger was held away from the fulminate by a small brass screw inserted into it through the side of the stock in a manner similar to that adopted in the Schenkl fuse. The fulminate cap, which was removable from the stock, was intended to be kept separate from the projectile when the latter would not be soon in use. When preparing for service a sufficient number of the caps were to be screwed into the fuses in the shells.

This fuse worked well, and would usually explode the shell on contact with water when the elevation was over five degrees, but as a time-fuse was considered as very desirable, particularly for use with the shrapnel, attention was turned to trials in that direction.

The first form of time-fuse tried had the composition disposed somewhat in the same manner as it appears in the service Bormann fuse—an igniter was placed in the center of the composition circle. The disk into which the composition was pressed was, however, movable around the axis of the fuse-stock, and could be set to any desired time within the range of the fuse-composition. The under side of the circle of composition was not covered, and communication was had with the magazine through a hole which lies within the path passed over by the exposed circle of the composition while turning. (Plate V, Fig. 2.)

The fuse-composition was lighted by an igniter, placed in the axis of the vertical part of the stock, and in the center of the circle of composition. The plunger carried fulminate on its lower face. It was held up from the frictional point by two arms which were intended to be broken by the sudden starting forward of the projectile on discharge of the gun. The plunger, being delayed by inertia, would be struck on the fulminate by the advancing point in the stock. The resulting detonation communicated flame to a powder channel, which filled the flash-chamber with gas, and through the hole made for the purposes inflamed the fuse-composition. This hole was continued through to the exterior of the movable part of the fuse, and formed the vent for the gas arising from combustion of the composition.

The plunger was kept in place, and its upper part was covered by a cap, which also pressed upon the movable and rotating part of the stock, and was intended to be screwed down tightly after the fuse was set for the desired time; thus the two parts of the stock were clamped firmly together.

It was soon found that this fuse would not work satisfactorily; the gas pressure in the composition groove forced the two parts of the stock apart, and the flame flashed quickly around the under side of the composition circle, firing the magazine or short time. Efforts were made to obviate this by covering the lower surface of the composition with foil and other material, but the action was never satisfactory. The column of composition was a little smaller in cross-section than that of the service Bormann fuse.

The next form seemed to promise better results. The stock was of hardened lead and was formed in one piece, having a flash and an ignition chamber in the center. Around this was pressed the circle of composition of the same form and volume as that of the service Bormann fuse, but (unlike the fuse just described) a "hornet" in this case covered the composition permanently, and was intended to prevent the flame from flashing around the circle in advance of the regular time. (Plate V, Fig. 3.)

One end of the composition was connected with the magazine by a passage, and the other end was blocked off as usual in Bormann fuses.

The composition-cylinder was divided on its circumference into time spaces. The plunger, which was considerably enlarged from that first described, was suspended to the cap by a zinc pin, which was to be broken by inertia on discharge of the gun. The plunger also carried fulminate on its lower face, and was furnished with powder-flash channels.

The top of the plunger was covered and protected by a cap, which screwed into the walls of the flash-chamber.

To prepare the fuse for use, pierce directly through the stock and composition into the flash-chamber, on a horizontal line, and at the required time mark, as shown by the arrow.

The discharge of the gun broke the arms of the plunger, which struck the advancing nipple; the fulminate was fired, and the powder in the channels ignited and filled the flash-chamber, finding its way through the vent bored, and igniting the composition, which burned both ways until the magazine was reached by the end connecte-



PLATE V.

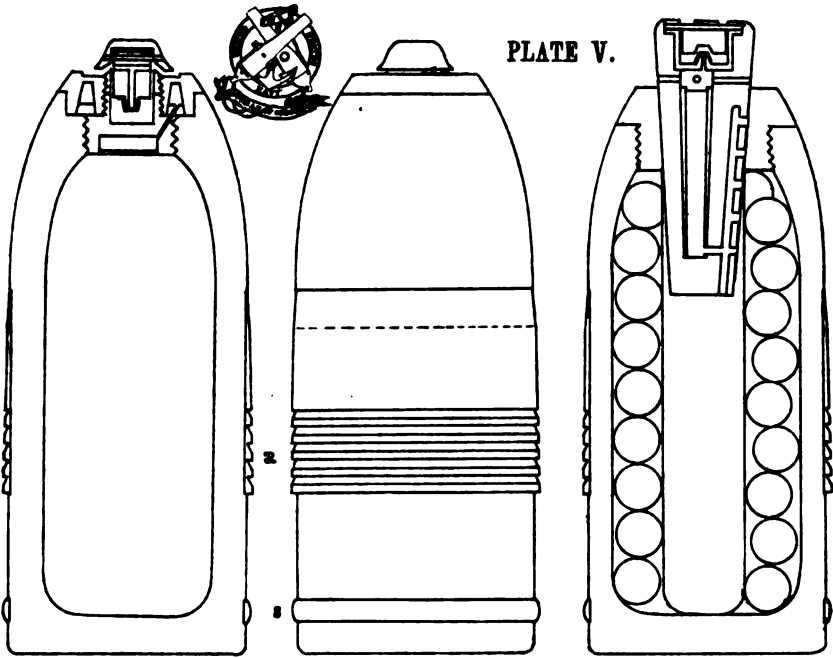


Fig. 1.

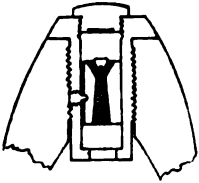


Fig. 2.

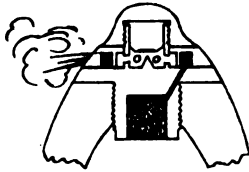


Fig. 3.

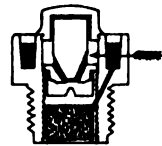


Fig. 4.

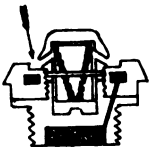


Fig. 5.

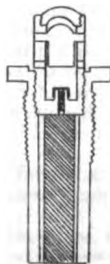


Fig. 7.

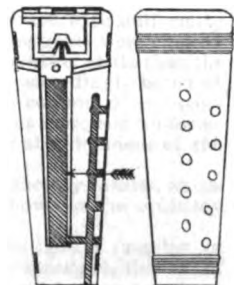
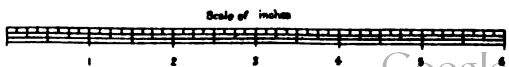


Fig. 6.





therewith. This fuse was simple, and appeared practical, but it could not be brought to show the necessary amount of regularity. The horseshoe being inserted from the upper side was frequently started upward by the action of the boring-tool, and the gas arising from the composition was then enabled to partially lift the shoe, and the fuse thus became very liable to premature ignition of its magazine. The action of the igniter was almost perfect, and the difficulty seemed to be altogether with the column of fuse-composition.

A minor defect of this form was the effort required to bore through the walls of alloy, and across the fuse-composition, before the flash-chamber could be reached.

The thickness of the walls could not be decreased, or bursting from internal pressure or melting from heat developed by the burning composition would have resulted; and in case the lead had been further hardened, and the thickness of walls had been reduced, the difficulty of boring would have been increased.

A change was then made in the form of the fuse-stock, with the object of reducing it in size, and also of changing the horse-shoe to the under side of the composition-cylinder, where some mechanical pressure could be put upon it to keep it in place. (Plate V, Fig. 4.)

The stock in this case is of bronze, with the composition-cylinder (of hardened lead) screwed down upon it, so that the horseshoe (now inserted from below) should bear firmly against the face of the stock.

It was also thought that the composition could be more easily pierced from the top of the fuse (as in the service Bormann); the tool would thus be required to pierce a less quantity of lead than before, and would not be driven through the composition, and thus breaking and cracking of the latter would be avoided. (See arrow.)

The igniter remained the same as last described.

As the composition was to be exposed at a point on the upper face of the fuse, it became necessary to conduct the inflamed gas from the flash-chamber to that face. This was done by piercing holes through the cylindrical part of the cap, under the shoulder, thus allowing the gas imprisoned in the flash-chamber to rush out and impinge upon the upper face of the fuse. Experiment showed that the volume and momentum of this gas was amply sufficient to ignite the composition. The direction of these gas-jets was determined by boring the holes in the cap at an angle, so as to throw the flame downward upon the face of the fuse, while the shoulder or rim raised around the outer edge of the time-face was partly intended to bank the flame somewhat within the circle lying immediately above the fuse composition, and partly to prevent the point of the piercing-tool (when hurriedly used) from slipping out of its proper place over the composition.

The cross-section of the composition was reduced to about one-half that formerly used, with a view to reducing size of fuse, and also heat developed.

This form of fuse was not quite as simple as that previously described, but seemed to promise a solution of the defects that had been before observed. The igniter worked well, and the flame from under the cap would ignite the composition readily. The composition burned quite well up to five seconds, but the time could not be carried beyond that point with any certainty of obtaining explosion of the shell, the composition appearing, as it were, to be smothered on the longer times.

The cross-section of the column of composition was next made equal to that of the service Bormann fuse, it being hoped that the increased volume of gas might improve the burning on times beyond five seconds; at the same time the flange or shoulder of the bronze stock was dispensed with, and the "horseshoe" over the composition was kept from moving by being pressed against the flattened nose of the shell itself when the fuse was once screwed into place. The fulminate recess in the lower part of the plunger was suppressed, and was replaced by a nipple, which held a percussion-cap. The powder-channels in the plunger communicated with this nipple. These changes resulted in the form shown. (Plate V, Fig. 5.)

Finding that it was still impossible to carry the burning composition with uniformity beyond five seconds during flight, it was thought that perhaps the gases were choked or confined by pressure of air on the point of the shell, and needed other vents than the one made by the piercing-tool at the initial point. Vents were accordingly bored at intervals, inward from the edge, (xx, Fig. 5,) so as to touch the column of composition. By this device the longer times were carried with somewhat increased uniformity; but the chief defect still remained, and led to the temporary abandonment of the fuse.

Fuses on the Bormann plan having thus far failed to give satisfactory results, an attempt was made to use the straight column of composition, as shown in the ordinary Navy time-fuse.

The water-cap was removed from the time fuse stock, and an igniter (similar in principle to that last described) was screwed into its place. Thus arranged, the fuse of course would only burn for the full time for which it was pressed, and no simple or practical means existed for setting the fuse to intermediate times.

At first the vents for the escape of gas from this fuse led upward, outside of the screw-

housing of the igniter; but it was found that unless a short and direct means of escape were given to the gas in a lateral direction, (i. e., not exposed directly to the pressure of the air, as it would have been if escaping from the top of the stock,) the residuum deposited by the gas soon clogged up the vents and smothered the flame, or else caused it to burst through prematurely. A change was, therefore, made, and the gas vents were led as shown. (Fig. 6.)

Not many experiments were made with this fuse; it was only considered as a makeshift, and not being capable of being set on any given time, it did not long attract attention.

Attention was next turned to the wooden stock, which can be pierced through the side for intermediate times. Beech was found suitable for the purpose, and the stock was coned on the outside. (Plate V, Fig. 7.)

A coned composition-channel was bored into this stock parallel to the axis, but one-tenth inch distant from it. This channel received the paper-case fuse, which was somewhat less in diameter than the regulation Navy time-fuse.

Just above the upper face of the fuse composition was an unoccupied space from which four gas-vent channels led to the outside of the stock above the point of the shell.

Immediately above this gas-vent chamber the bore of the stock was considerably enlarged to receive the igniter. This consisted of a small bronze hollow cylinder, closed at the lower end, where it was furnished on the inside with a pierced nipple for percussion cap. The upper edge of the hollow cylinder was flanged in such a manner as to rest on top of the stock, thereby preventing the igniter from being driven bodily into the fuse on discharge of the gun.

Inside of this hollow cylinder the plunger was hung on a brittle wire, (half copper and half lead.) When this arrangement was in place the head of the fuse was covered with a piece of paper or linen luted down and shellaaced. Thus far the fuse only burned for the full time for which it was pressed. In order to provide for intermediate times, two side channels were bored from the lower end of the fuse upward, (one of these is shown in the figure.) Holes bored at equal intervals from the outside of the stock connect the exterior of the fuse with the side channels, the lowest communicating hole in each channel being bored entirely through to the fuse composition. The channels were filled with mealed powder and paper pasted over the exterior of the communicating (or time) holes, which were arranged as shown in the plate. The upper and lower ends of the stock were served with brass wire.

This fuse (which is virtually the English Boxer) works as follows: With a suitable tool pierce through the communicating hole (which corresponds to the number of seconds desired) into the column of fuse-composition, (see arrow,) then push the fuse by hand (giving it a slight twist) into the nose of the projectile and load the gun. On explosion of the charge the igniter acts as usual, and the fuse-composition runs down to the point at which it was pierced. Then the flame flashes into the side channels, down the latter to the lower communicating hole, and thence to the burning charge.

If for any reason the flame should not pass through the hole bored at the desired time, the fuse would still act at the end of its time of burning by igniting the charge through the lower communicating hole. If the shell strikes the object before sufficient time has elapsed to enable the composition to burn to the lower end, it is probable that the stock would be split and the whole be driven inward; in which case it would act as a concussion fuse.

This fuse performed well during experiment, but still did not burn as regularly as could have been desired. About two-thirds of the number tried did not vary, in burning, over a half a second, more or less, from the required time. The other third were irregular in their performance, showing, occasionally, as much variation as a second and a half. The fuses heretofore made have been pierced with side holes, only a whole second, running up to ten. It is proposed to try (for ordinary shrapnel ranges) a five-second fuse pierced to half seconds.

During the course of this work some trials were made of columns of fuse composition pressed after an Italian method. The composition is pressed (by hand) into a lead pipe considerably greater in diameter than the finished column is intended to be. The pipe is then passed through rolls, and is reduced gradually to the size desired; this, of course, resulting in a lengthening of the composition-stick. This proceeding packs the composition very uniformly, and when burned by hand equal lengths burn in equal times with great regularity.

This column has been tried in the wooden-stock (or Boxer) fuse, but did not succeed well. The lead pipe was too thick and heavy, and, by virtue of inertia, swept through the bottom of the stock into the interior of the shell on discharge of the gun, and notwithstanding the fact that the pipe was somewhat coned on the outside by hand. It is thought, however, that further experiment will be made in this direction.

This composition column has also been used in the fuses on the Bormann principle (figured at 3, 4, and 5, Plate V.) It improved the regularity of burning of the fuse but the performance was still unsatisfactory.

The Italians use the pipe in a fuse somewhat similar in plan to a combination of Nos. 2 and 3, but with what degree of success is not known.

No satisfactory fuse for shrapnel has been devised abroad or in this country. During the Franco-Prussian war the Germans used percussion-fuses exclusively; the French, time-fuses. Both were dissatisfied with the results and have since been experimenting; Germans on time-fuses, French with percussion.

NOTE IX.—*Metallic cartridges*.—During the elaboration of this armament, extended experiments were made with metallic cartridges. At one time it was intended to use for the charge of the gun a cake of compressed powder, which required a metallic case to properly develop its advantages. (Plate III, 47.)

This cake consisted of a hollow cylinder of powder, the grains of which were agglomerated (under a pressure of fifteen tons) sufficiently to bear transportation in the ammunition-boxes. It was intended to be ignited on the interior walls, and to burn from thence, on an increasing surface, toward the exterior, the rapidity of combustion of different charges being readily controlled by the amount of pressure used in making up the cake.

As compared with equal weights of loose cannon-powder from the same lot these cakes had slightly the advantage in range, and in uniformity of results, but not on the whole sufficient to weigh against the objections of increased expense, and of the undue elaborateness of such special ammunition. The compressed charge was therefore abandoned, and with it the necessity for metallic cases ceased.

Nevertheless, it is important to preserve the knowledge that has been acquired in the course of these experiments, because an efficient accelerating cake, or built-up charge, may at any time be brought forward, and in such an event the stiff metallic wrapper may be of special importance.

Early in the course of these experiments it was found that to produce a simple and efficient case would be a matter of considerable difficulty, and that small variations in the character of the material used, and in the method of assembling the parts, made great differences in the behavior of the case when subjected to the test of firing.

The principal accidents which occurred to the early and imperfect forms of cases were as follows:

First. The permanent expansion of the cylindrical part of the case against the walls of the powder-chamber, while the base cups were firmly held in the extractor-recess.

Second. A separation of the base cups from the cylindrical part of the case, the former being found more or less deformed at or near the extractor-recess, while the latter would be either permanently expanded against the walls of the powder-chamber, or else entirely crushed up in the bore.

Third. The punching of the base-cups by gas pressure, immediately over the interior orifice of the vent. This accident is followed by a rush of gas from the vent, the same as though a "check" at that point had not been attempted.

Fourth. The "shearing" of the tin cylinder circumferentially (from internal gas pressure) over the upper edge of the inferior cup; in short, this frail case being required to withstand an enormous pressure from the inside, gave way wherever there occurred a weak or unsupported point, and the gas instantly forced its way out.

The occurrence of the first of the accidents just mentioned usually rendered the unlocking of the breech extremely difficult, and, indeed, any imperfect action of the case was generally indicated by more or less opposition to unlocking.

It was found that defects of the class first mentioned arose from two causes: First, the cylindrical form of the powder-chamber. This was afterward changed to a truncated cone of very slight inclination. The second cause was an insufficient coning of the cartridge-case itself, whereby the solder seam on the body was not given a proper opportunity to split. It was found that, when this split did not occur, the case usually stuck in the gun. In order to facilitate splitting, it was found necessary to use as little solder as was consistent with a proper closing of the seam.

Defects mentioned under the second head were caused by the primer-gas issuing from the interior orifice of the vent in the plug, and driving the case too far forward into the powder-chamber. The force of the blow delivered by the primer-gas is much greater than would be supposed, and is more than sufficient to drive the case close up to the base of the projectile. The case being thus driven forward and its charge ignited, the cylinder became permanently expanded, and stuck at the point at which the case had arrived, while the base-cups were pushed backward (by the longitudinal thrust) into the extractor-recess, or else the separated parts, being too slow in their motions, allowed the gas to get behind them, in which case all were crumpled up and deformed, and usually left in the chamber too hot to be touched by the hand.

Finally, around the exterior cup a bead was raised, which, by bearing against the rear edge or knuckle of the powder-chamber, prevented the case from being driven forward, and obviated the above-mentioned difficulty.

The third defect mentioned merely required the strengthening of the metal over the interior orifice of the vent. This was done by introducing through the base-cups, over

the orifice of the vent, a rivet, the head of which gave the metal of the base-cup sufficient support against the punching effect of the powder-gas.

The fourth defect was finally remedied by raising the rim of the inner base-cup somewhat above that of the outer cup, thus interposing a layer of sheet-brass between the tin cylinder and the gases at the point where the former often sheared across the edge of the outer cup.

For a long time the various parts of the cartridge-case were joined to each other by drops of solder, but it was finally concluded to dispense with the solder, and to crimp the inner cup and the tin cylinder into the groove made on the interior of the outer cup by the beading.

This simple arrangement held all parts firmly together, and the case so assembled, and made of material of good quality, will bear all the pressure it should be called upon to sustain, and will extract with certainty.

It is very important in bronze guns using metallic cartridges that the case should not burst, because the gas rushing violently from a leak will soon score the shoulder or edge of the powder-chamber badly.

A small gutter being thus established, and support being withdrawn from the case at this point, future failures are almost certain to take place at the same spot. Thus the face of the chamber is soon badly cut out, and will require either to be reamed forward or to have the holes filled, either being an undesirable process.

Standard drawings and patterns of the metallic case in its latest form are preserved at the ordnance department, Washington navy-yard.

The charge within the metallic case is ignited as follows: A disk, having a vent in the center, is soldered to the base of the outer cup, and the flame from the primer passes through it, and then through four ignition-holes pierced in the base-cup proper. The space between the ignition-holes is strengthened by the insertion of the rivet, the head of which, overlapping the edges of the vent, becomes a sort of "vent-check."

Before the introduction of the hardened bronze gun, leaden belts were used on the projectiles, and a lubricant was necessary to partially prevent "leading" of the bore. The cake of lubricant was half an inch thick, and was placed on top of a layer of paper over the powder. It was then covered with pasteboard, and the points of the metallic case were turned over the whole. The lubricant consisted of a mixture of tallow and oil. The same lubricant was also used in a groove on the rear belt of the projectile, and was retained in place by a few turns of yarn.

There is, of course, no vent-check or Broadwell ring used with the metallic case, as the functions of both of these are performed by the case itself.

NOTE X.—*Powder-gas pressures and range.*—Pressure indications have been obtained chiefly with the light gun. The instrument used was a very small pressure-piston, the impression-face being a re-entrant spiral, (area, one-sixth of a square inch. This was placed in a housing, and was screwed into the forward face of the plug, the top of the housing being nearly flush with the bottom of the nose-plate recess. It was necessary to unscrew the housing after each round and extract the pressure-disk, which was made of annealed copper.

The following table shows the principal results thus far obtained:

*Table of pressures observed in the bores of 3-inch howitzers.*

Gun.	Kind of powder.	Feet by gun-pendulum.	Weight of charge.	Weight of projectile.	Number of rounds observed.	Average pressure.	Average difference from the mean.
Light .....	Ordinary C. P. ....	1,536	Oz. 12	Lbs. 7	11	18,150	1.19
Do .....	do .....	1,536	12	8	12	19,170	
Do .....	Large grain, old rifle. ....	1,470	12	7	10	13,235	
Do .....	do .....	1,470	12	8	2	15,100	
Heavy .....	Ordinary C. P. ....	1,536	16	8	2	22,500	

It was only possible to obtain two pressure-indications from the heavy gun for want of a suitable breech-plug to use with the gauge.

An examination of the classification of the powders by the gun-pendulum, as compared with the corresponding pressures and "difference from the mean," will show how much more moderate and uniform is the action of the large-grain powder in the gun than that of the quick C. P.

Judging from the tabulated record of the light gun, it is probable that the pressure

in the bore of the heavy gun, when using the larger-grained powder and 8-pound projectile, will be about 19,000 pounds. In connection with the foregoing table an examination of that in the latter part of this note will show that the large-grain powder does nearly as well at 5° elevation as the smaller grain, but with much less strain on the gun.

In most of the practice at the navy-yard, Washington, the quick small-grained cannon-powder was used, because the object of the experiments was usually to strain the breech-closing apparatus, and also the projectiles and metallic cartridges, as much as possible. Under such treatment defects often appear that would not otherwise be detected.

Ranging is done at the experimental battery, Annapolis, Md., and thus far that establishment has been able to use only a steel howitzer of the light pattern. A few of the ranges, &c., obtained from this gun are given in the annexed table, and include the jump of the field-carriage, which has not yet been accurately determined. It operates, however, to increase the range over that due to the elevation by quadrant.

The action of the projectile was observed by plane-table over water; not as accurate a method as that in which screens are employed.

The light gun is a more powerful piece than the English steel 7-pounder bont-gun, or the French naval *canon de quatre*. The projectile of the latter weighs nearly nine pounds.

*Table of ranges, deflections, muzzle-velocities, &c., of 3-inch howitzer shells, weighing 7 pounds.*

GUN—STEEL HOWITZER, A.

Kind of powder.	Kind of case.	Elevation.	Mean range.	Mean reduced deflection.	Mean time of flight.	Muzzle-ve of shell.
		Deg.	Yards.	Yards.	Seconds.	Ft.
Ordinary C. P. ....	Metallic ...	1	761	2.1	2.5	1,094
Do .....	do .....	2	1,095	2.7	3.65	1,094
Do .....	do .....	3	1,400	2.0	4.65	1,094
Do .....	do .....	4	1,662	2.2	5.63	1,094
Do .....	do .....	5	1,940	4.7	6.65	1,094
Do .....	do .....	7	2,440	3.1	8.81	1,094
Do .....	do .....	10	2,933	9.9	11.47	1,094
Do .....	Serge .....	5	1,934	1.8	6.7	1,069
Do .....	do .....	7	2,361	2.2	8.52	1,069
Do .....	do .....	10	2,972	3.1	11.42	1,074
Large grain, old rifle .....	do .....	5	1,927	2.3	6.54	1,071

The experiments for range and accuracy of the heavy gun are now going forward.

NOTE XI.—*Wear*.—The amount of wear shown by the bores of these guns is a very important point, and has met with such attention as could be given it in the course of manufacturing.

The rear part of the bore is not on the whole as hard as the chase and muzzle parts, because the metal composing the former, being originally a larger mass, is not relatively as much 'chilled, and would not, consequently, be as much hardened, as the latter by the same amount of mandreling. In some of the guns the wear at first has been slightly more rapid at the rear end of the bore than at the other parts. As the firing proceeds the wear appears to become more uniform along the whole length of the bore.

The wear will of course vary with the quality of the metal composing each particular gun.

When the guns are new the surface of each rib is beautifully smooth, and remains so after firing, notwithstanding that the bore may be somewhat worn.

The copper belts on the projectiles are much hardened by forcing through the compression-slope, and an attempt has been made to ascertain the amount of this hardening by impressing with a small indenting knife the belts of some of the projectiles recovered after having been fired through the bore. A constant pressure of 1,000 pounds was used upon the knife.

It was found that the forcing had increased the hardness of the copper belt (where the latter had been pressed directly under a rib) about one and one-half times, and the hardness of the metal where it had squeezed from under the ribs and filled the grooves was only a trifle less.

By the same system of comparison, a "skin specimen" taken from the expanded bore of one of the guns (R) showed somewhat harder than the forced belt of the projectile.

The following table, though compiled from the records of different guns, (of course varying somewhat in original quality of metal,) may be accepted as exhibiting the rate of wear that will probably be shown in service. The table of comparative hardness of bore and belts is appended, to which are added some tests of steel, &c.

The Nashua howitzer referred to is very mild and soft in quality; too much so for an efficient service-gun of any large size. The chrome steel specimen was only a bar.

*Table showing the amount of wear observed in the bores of hardened bronze howitzers after firing.*

LETTER OF GUN, Q.

Rounds.	Enlargement.		Chase and muzzle.
	Near seat of projectile.	About Trunnions.	
	<i>Seconds.</i>	<i>Seconds.</i>	<i>Seconds.</i>
From round 33 to round 58 .....	0.000	0.001	0.003
From round 58 to round 73 .....	0.002	0.002	0.003
From round 80 to round 130 .....	0.003	0.003	0.003

*Exhibit of the comparative hardness of expanded bore of bronze 3-inch howitzer; of belts of projectile before and after being forced, &c.*

Metal.	Length of cut made by a pressure of 1,000 pounds on the indenting knife.	
	<i>Seconds.</i>	
Surface of bore of ordinary bronze gun, (C, 500 pounds) .....	0.270	Mean hardness between breech and muzzle. Do.
Skin of hardened bore of gun, (R, 350 pounds) .....	0.223	
Copper belt on projectile before being fired through gun .....	0.423	
Copper belt on projectile after being fired through gun .....	0.249	
Hardness shown by a specimen of ordinary wrought-iron .....	0.217	
Hardness shown by a specimen of steel howitzer, (Nashua No. 1) ..	0.242	
Hardness shown by a specimen of bar chrome steel, (No. 2) .....	0.177	

*Manufactures and preparations at the various navy-yards for the year ending June 30, 1876.*

ARTICLES UNDER PROPORTION TO EACH GUN.

13 shell-whips.	16 XI-inch sponge-caps.
16 turret-whips.	6 60-pounder sponge-caps.
11 XI" preventer-breechings.	5 XV-inch sponge-caps.
2 sets 60-pounder-gun gripes.	1 X-inch sponge-cap.
4 sets XI-inch-gun gripes.	1 60-pounder carriage.
4 sets IX-inch-gun gripes.	16 shell-stands.
343 swabs.	5 transom-quoins.
30 XI-inch sabots.	2 60-pounder chamber-scrapers.
8 supply-boxes.	2 60-pounder bore-scrapers.
21 primer-boxes.	3 XV-inch bore-scrapers.
24 XI-inch shrapnel.	4 XI-inch tampions.
485 IX-inch shrapnel.	38 IX-inch tampions.
50 60-pounder shrapnel.	26 IX-inch tampions and wads.
9 100-pounder shrapnel.	4 60-pounder tampions.
7 XV-inch shrapnel.	6 XV-inch tampions.
30 32-pounder shrapnel.	3 XV-inch tampions and wads.
30 30-pounder shrapnel	2 20-pounder tampions and wads.
5 XV-inch shrapnel, L. & F.	1 X-inch tompon and wads.
30 32-pounder shrapnel, L. & F.	16 port-bridles and tricing-lines.
71 60-pounder shell.	56 gun-tackles.
9 100-pounder shell.	18 heavers for selvagees.
309 XI-inch shell.	54 division-boxes.
601 IX-inch shell.	3 stationery-boxes.
46 XV-inch shell, L. & F.	6 division-tubs.
130 32-pounder shell.	6 fire-tubs.
130 32-pounder shell, L. & F.	1 XI-inch ladle.
78 30-pounder shell.	1 IX-inch ladle.
144 20-pounder shell.	3 XV-inch ladles.
40 20 pounder shell, L. & F.	1 X-inch ladle.
110 IX-inch sponge-caps.	2 20-pounder ladles.



- 2 dark-lanterns.
- 14 XI-inch muzzle-bags.
- 9 XV-inch muzzle-bags.
- 6 IX-inch muzzle-bags.
- 4 60-pounder muzzle-bags.
- 2 20-pounder muzzle-bags.
- 3 shackle-pin punches.
- 84 chocking-quoins.
- 100 lock-springs.
- 72 lock-lanyards.
- 8 lock-aprons.
- 53 lock-apron straps.
- 232 fire-bucket lanyards.
- 4 VIII-inch roller-handspikes.
- 72 roller-handspikes.
- 6 20-pounder roller-handspikes.
- 10 20-pounder ordinary handspikes.
- 33 IX-inch rammers.
- 3 XV-inch rammers.
- 6 XV-inch rammers, sectional.
- 1 X-inch rammer, sectional.
- 153 wash-deck chocks.
- 292 port-lanyards.
- 25 port-lanyard hooks.
- 6 60-pounder vent-compressors.
- 2 150-pounder passing-boxes.
- 9 100-pounder passing-boxes.
- 8 32-pounder passing-boxes.
- 5 XV-inch passing-boxes.
- 4 XI-inch breechings.
- 38 IX-inch breeching.
- 23 60-pounder breechings.
- 2 20-pounder breechings.
- 35 thumb-stalls.
- 26 IX-inch woolen sponge-covers.
- 35 XI-inch woolen sponge-covers.
- 8 60-pounder woolen sponge-covers.
- 2 100-pounder woolen sponge-covers.
- 1 32-pounder woolen sponge-cover.
- 1 20-pounder woolen sponge-cover.
- 10 XV-inch woolen sponge-covers.
- 42 port-bridles.
- 23 shell-stand braces.
- 67 side-tackles.
- 5 train-tackles.
- 2 60-pounder Marsilly carriages.
- 26 IX-inch carriages.
- Iron-work :
- 150 shell-plugs.
- 5 roller-handspike castings.
- 1,026 IX-inch-shell boxes.
- 1 XI-inch-shell box.
- 4 32-pounder-shell boxes.
- 1 axle for gun-carriage.
- 2 housing-straps.
- 8 sets 60-pounder castings.
- 40 60-pounder breeching-thimbles.
- 16 IX-inch breeching-thimbles.
- 4 20-pounder breeching-thimbles.
- 6 breeching shackle-pieces.
- 6 breeching splice-pieces.
- 2 sets breech shackle-bolts.
- 29 pivot-bolts.
- 52 eyebolts.
- 2 ring-bolts.
- 4 light bolts.
- 63 bolts.
- 63 nuts.
- 6 pairs friction-chocks.
- 16 division-bags.
- 6 shell-box covers.
- 22 XI-inch trunnion-rings.
- 9 60-pounder directing-bars.
- 1 breech-plug.
- 1 Broadwell ring.
- 1 XI-inch buffer-carriage and deck-circles.
- 2 sections of IX-inch shell.
- 2 sections of IX-inch shrapnel.
- 4 extractor-hooks.
- 78 handspike-hooks.
- 3 turret-sights.
- 1 XI-inch gun, side-sighted.
- 2 60-pounder friction-chocks.
- 8 XV-inch vent-drills.
- 8 XV-inch trunnion-ledges.
- 1 XV-inch loading-ladle.
- 15 XV-inch boring-bits.
- 3 XV-inch breech-sight aprons.
- 5 XV-inch priming-wires.
- 2 XV-inch (sets) vent-punches.
- 3 XV-inch worms.
- 1 20-pounder worm.
- 2 cartridge-bag formers.
- 2 XV-inch gauges.
- 5 shot-tongs.
- 4 metal blocks for whips.
- 2 cranks for XV-inch carriage.
- 8 XI-inch metal blocks.
- 8 IX-inch metal blocks.
- 4 sets hoops and heads, XV-inch powder-box.
- 6 XV-inch sponges, (sheep-skin.)
- 1 X-inch sponges, (sheep-skin.)
- 2 XV-inch sponges, (bristle.)
- 4 shell-loaders, (XV-inch.)
- 10 junk-wads, (XV-inch.)
- 50 eel-vage-wads, (XV-inch.)
- 1 star-gauge ring, (13 $\frac{1}{2}$ -inch, W. P. F.)
- 1 star-gauge point.
- 6 XV-inch rear sights.
- 6 XV-inch rear-sight covers.
- 12 XV-inch rear-sight bolts.
- 12 XI-inch rear-sight bolts.
- 12 XI-inch rear-sight covers.
- 6 XV-inch front sights.
- 12 XV-inch front-sight screws.
- 6 cannon-locks.
- 6 cannon-lock bolts.
- 2 20-pounder bronze carriages.
- 2 20-pounder breast-pieces.
- 8 20-pounder becketts.
- 1 XI-inch breech-loading rocket-gun.
- 63 plugs.
- 3 thimbles.
- 1 set fitting-lamp.
- 1 lever gun-carriage.
- 1 XV-inch sponge section-staff.
- 1 sub-caisson, painted.
- 1 sub-carriage and slide, painted.
- 1 X-inch rammer, painted.
- 1 X-inch worm, painted.
- 1 shot-tong, painted.
- 1 shot-ladle, painted.
- 1 former passing-boxes, 8-inch rifle.
- 51 handspike shoes.
- 200 handspike-shoe rivets.
- 1 XI-inch carriage and slide, complete

## HOWITZERS, EQUIPMENTS, ETC.

198 12-pounder-rifle shell.	26 breast-lashings.
214 12-pounder heavy shell.	9 drag-ropes.
18 12-pounder light shell.	10 sponge-covers, (sheep-skin.)
90 12-pounder heavy shrapnel.	14 3-inch breech-loading howitzerhar-
156 12-pounder light shrapnel.	ersacks.
18 12-pounder heavy canister.	94 howitzer-wheels.
2 12-pounder clamps.	16 howitzer-wheel boxes.
100 ammunition-rings.	33 sponge-buckets.
1 set boat-skids.	8 hoops and heads.
4 sets boat-tracks.	4 steel howitzers.
27 12-pounder sponge-caps.	1 gas-escape vent.
6 shoes for howitzer-wheels.	56 rail-sockets for Gatling gun.
30 12-pounder tampons.	700 sabots for 3-inch shell.
7 boat-chests.	25 3-inch breech-loading howitzer
6 12-pounder woolen sponges.	wrenches.
5 24-pounder passing-boxes.	18 crescent bolts and pins.
96 3-inch breech-loading howitzer pass-	8 blocks metallic-cartridge case.
ing-boxes.	4 carriage-wrenches.
62 caisson-boxes.	3 gun-covers.
Iron-work :	4 gun-nipples.
6 wads.	3 rammer-covers.
10 12-pounder Schenkl shell.	17 spare-article boxes.
1 canvas cover for Gatling gun.	330 sabots cartridges.
14 breech-sights.	4 dummy-shot.
25 field-carriages.	2 stands for Gatling gun.
16 bronze howitzers.	12 friction-primer lanyarda.
4 nose-plates.	4 boring-bits.
34 nose-plate screws.	4 back-ropes.
19 gas-checks.	8 primer-boxes.
15 elevating-screws.	36 linchpins.
1 double elevating-screw.	2 bristle sponge-heads.
4 elevating-screw pins.	1 center-shaft, covered.
1,567 3-inch breech-loading howitzer	3 12-pounder L-iron boat-carriage
shells.	9 12-pounder pivot bolts.
300 breech-loading howitzer cartridge-	100 3-inch breech-loading howitzer-car
cases.	tridges.
4 boat-carriages.	2 12-pounder L-iron boat-carriages,
1 boat-carriage, altered.	painted.
10 3-inch breech-loading howitzer ram-	3 24-pounder muzzle-bags.
mers.	5 field-carriages, Gatling gun.
10 3-inch breech-loading howitzer	5 transportation-boxes.
sponges.	4 12-pounder-gun tackles.
520 3-inch breech-loading howitzer cart-	8 24-pounder tackles.
ridge-bags.	2 impression, inspection boro.
200 metal-case cartridges.	

## SMALL-ARMS, ETC.

6 arm-chests.	50 cartridge-boxes, rifle.
12 arm-chest hinges.	6 oil-cans.
6 arm-chest hasps.	19 gallons lacquer.
11 canvas chest-covers.	1,753 rifle rear-sight guards.
95 waist-belts.	293 cutlass-scabards.
18 revolver-frogs.	1,500 blocks for rifle-cartridge boxes
27 revolver-boxes.	

## MAGAZINE-STORES.

21 magazine-hose.	563 IX-inch-cartridge bags.
17 magazine-hose spanners.	100 XV-inch-cartridge bags.
2 magazine-hose couplings.	220 24-pounder-cartridge bags.
7 magazine-screens.	1,010 12-pounder-cartridge bags.
8 powder-whips.	200 3-pound saluting-charges.
2 powder-dishes.	21 magazine-dresses.
1 powder-funnel.	16 magazine-shoes.
4 powder-messures.	3 copper-bound cans.
2 candle-molds.	3 copper-bound buckets.
1,848 32-pounder-cartridge bags.	3 portfire-boxes.

## Iron work :

11,823 Navy time-fuses.  
 11,860 Navy time-fuse cases.  
 4,567 Bormann fuses.  
 40 percussion-fuses.  
 120 pounds shell-powder.  
 5 powder-bearers.  
 4 powder-buffers.

1 hopper.  
 1,200 fuse-plugs.  
 4 cartridge-bag formers.  
 9,482 cannon-primers.  
 242 cartridges, 12-ounce, serge bags.  
 80 cartridges, 12-ounce, metallic case.  
 5,930 Bormann fuse stocks.  
 1 feed-table for powder-press.

## MISCELLANEOUS ARTICLES.

7 powder-chutes.  
 1 plan of magazine and shell rooms.  
 2 IX-inch passing-scuttle funnels.  
 53 tank-tallies.  
 8 clevis-bolts.  
 9 IX-inch passing-scuttles.  
 14 rammer-brackets.  
 12 shell-box stands.  
 18 target-frames.  
 1 pendulum.  
 2 target-straps.  
 2 chain gun-slings.  
 30 post-sweeps.  
 4 gallons stain.  
 1 Parrott die-plate.  
 3 post-sweep bolts.  
 2 wrenches.  
 13 tin cans.  
 2 passing-boxes.  
 1 grindstone-frame.  
 48 tally-boards.  
 85 packing-boxes.  
 1 former for XV-inch passing-boxes.  
 83 sets boarding-pike brackets.  
 195 fire-bucket hooks.  
 29 lantern-hooks.  
 18 rigging-stoppers.  
 4 target-screens.  
 176 pair pistol-brackets.  
 2,652 deck-screws.  
 1 whip for loading-traveler.  
 754 whip-circle screws.  
 6 eccentric-rods and strap-pins.  
 4 piston-rings and screws.  
 4 brasses, connects, rods.  
 2 backing truss-bands.  
 20 pair hand-spike hooks.  
 36 dead-eyes.  
 8 sets deck-circles, sweeps.  
 233 pairs batten-brackets.  
 8 bronze castings for launch.  
 40 rollers for drawings.  
 2 handles for flood-cocks.  
 2 grubbing-hoes and picks.  
 2 grubbing-hoe and pick handles.

1 protractor-ruler.  
 1 target.  
 1,530 pounds bloom-iron.  
 1 canvas ball for life-buoy.  
 100 handles for powder-tanks.  
 1 set tallies.  
 1 bronze table-top.  
 24 standard starts.  
 1 range-table.  
 20 cutlass-beckets.  
 8 axle-beckets.  
 8 vent-wire beckets.  
 2 sets lightning-rods.  
 90 cutlass-brackets.  
 77 vent-wire brackets.  
 2 railroad-cars for magazines.  
 1 submarine caisson.  
 7 cocks, caisson.  
 2 valves, caisson.  
 7 cock-wrenches and handles.  
 2 caisson-pumps.  
 4 chocks.  
 40 cleats.  
 6 ring-bolts.  
 1 crane, complete.  
 4 braces for caisson.  
 1 ring-valve for rubber collar.  
 1 lever-valve.  
 1 tank passing-box.  
 1 submarine caisson, painted.  
 1 platform for sighting-instrument for guns.  
 1 pattern for casting sighting-instrument.  
 14 XI-inch trunnion-caps.  
 50 leather hose-washers.  
 13 powder-scuttle frames.  
 12 powder-scuttle levers.  
 16 powder-scuttle hooks.  
 16 powder-scuttle nuts.  
 60 brass hooks.  
 1,016 blank-bolts.  
 3 rollers for steam-derrick.  
 1 pair sculls for ordnance-dock.  
 35 scuttle-wrench brackets.

## TORPEDOES, ETC.

12 sets complete torpedoes, prepared.  
 16 bridles, wire.  
 8 guys, wire.  
 8 topping-lifts.  
 8 guys, manila.  
 1,031 feet ash, Scotchman.  
 10 torpedo-tackles.  
 20 torpedo-guys.  
 3 sets torpedo-gears.

20 25-pound torpedoes.  
 1 torpedo-boom shackles and attachments.  
 4 50-pound torpedoes.  
 36 sheet-copper.  
 6 torpedo-spar spans and guys.  
 Repairs to deteriorated stores on hand.  
 Repairs to tools, &c.  
 Repairs to buildings, wharves, &c.

## No 7.—BUREAU OF MEDICINE AND SURGERY.

NAVY DEPARTMENT,  
BUREAU OF MEDICINE AND SURGERY,

November 1, 1876.

SIR: Herewith I have the honor to submit the report of this bureau for the past year, together with estimates for the support of the Medical Department of the Navy for the fiscal year ending June 30, 1878.

## ESTIMATES.

The following tabular statement exhibits the several amounts appropriated for the Medical Department of the Navy in the years enumerated and the estimates for 1877-'78:

	Appropriations.					Estimate 1877-'78.
	1872-'73.	1873-'74.	1874-'75.	1875-'76.	1876-'77.	
Surgeons' necessities and appliances.....	\$40,000	\$40,000	\$30,000	\$30,000	\$30,000	\$40,000
Repairs and improvements of hospitals....	25,000	25,000	5,000	20,000	10,000	40,000
Contingent.....	25,000	25,000	25,000	25,000	15,000	25,000
Civil establishment.....	73,372	75,204	39,161	35,000	25,000	43,922
Total.....	163,372	165,204	99,161	110,000	80,000	150,922

On examination, it will be observed that the estimates for the next fiscal year are higher than the sums appropriated for the present year, but in general lower than the average of appropriations for several years previously. The aggregate of the estimates for the coming fiscal year is \$12,450 less than the appropriations for the year 1872-'73, and \$14,282 less than those of the year 1873-'74.

Compared with the two years just mentioned, the appropriation for the current fiscal year shows a reduction of fully fifty per cent. The branches of the hospital service, which have suffered most from this reduction, are those least able to bear it. They are the "civil establishment" and "repairs and improvements," on the former of which depends the efficiency of the *personnel*, including nurses and other attendants on the sick, and on the latter the ability of the bureau to maintain the hospital buildings and appendages in a suitable condition for the accommodation of the sick. The appropriations for the current year are entirely inadequate to the proper support of the naval medical service, however prudently administered. This being the case, as the official guardian of the sick of the Navy, I feel it incumbent upon me to urge the expediency of larger appropriations than have been granted the last two years, and of a closer approximation to those which my own experience, supplemented by that of my immediate predecessors in office, has found to be indispensable. If a contrary practice has ever prevailed, certainly of late years economy in the administration of the funds intrusted to the Bureau of Medicine and Surgery has been the rule; but during the present year (and to a considerable degree during the previous one also) the economy exercised has almost amounted to parsimony, and in respect to the service at hospitals, it may well be feared, has been attended with a denial to the sick of some of the comforts to which they are entitled.

## CIVIL ESTABLISHMENT OF HOSPITALS.

Under this head are embraced all attendants upon the sick, with such other persons, not officers of the Navy, as may be connected with the administration of the hospital service. The employés of the United States Naval Laboratory are also a charge upon it. For the last two fiscal years this appropriation has been so small as to be entirely below the requirements of the service. To eke out deficiencies in the way of nurses and other immediate attendants on the sick, the most undesirable make-shifts have been occasionally resorted to. From the necessity of the case, convalescent patients, or the less infirm, have been compelled to take care of and wait upon their more disabled or helpless comrades. In the seasons of sickness on board ship no persons could sympathize more warmly with, or show greater willingness to assist, an afflicted ship-mate than sea-faring men. There the unavoidable absence of trained help makes friendly attendance on the sick a necessity, which is recognized and yielded to with cheerfulness by all. But at hospitals on shore the sick of all grades and classes feel themselves entitled to receive such offices at the hands of persons paid for the purpose by the Government, and nothing creates greater dissatisfaction among them than to be called on to perform the duties of nurse toward others only perhaps a little more disabled than themselves.

A cursory glance at the appropriations for "civil establishment of hospitals" during the last few years will show how great a reduction in the number and wages of employés has actually taken place. The amounts for the years ending June 30, 1873, 1874, 1875, and 1876 were, respectively, \$73,372, \$75,204, \$39,161, \$35,000, and for 1877 only \$25,000. The pay-rolls of the five principal naval hospitals for the first-named year, as compared with the current year, give for Chelsea 23 attendants, at \$8,824.32, against 13 attendants, at \$2,280; New York, 34 attendants, at \$11,680.80, against 18 attendants, at \$5,400; Philadelphia, 25 attendants, at \$7,395.84, against 11 attendants, at \$2,799.96; Norfolk, 21 attendants, at \$6,856.80, against 13 attendants, at \$2,520; and Mare Island, 20 attendants, at \$8,823.84, against 9 attendants, at \$4,080. In neither of the years 1873 or 1874 was the number of employés or their scale of compensation excessive; on the contrary, they were merely sufficient to enable the bureau to maintain these large establishments on a satisfactory footing. While in no branch of the public service should the slightest approach to extravagance or waste be countenanced, a due regard to the instincts of humanity and the efficiency of the Navy demands that the provision for its sick and disabled, ashore and afloat, should not fall below that standard of liberality which is alone compatible with their comfortable care and earliest possible restoration to health. More than this would partake of the nature of waste; less, would be an act of injustice and wrong to the beneficiaries of the hospital department.

The estimates herewith submitted for the "civil establishment of hospitals" result from a critical revision of the combined recommendations made by the several medical officers in charge, and are believed to be at once sufficient for the purpose and moderate in themselves. As no one can know as well as the naval medical officer what the indispensable wants of the service really are, and the present incumbent of the bureau has uniformly striven to reconcile the just claims of the sick with the observance of a wise economy, the estimates are commended with entire confidence to the consideration and approval of the head of the Department.

## REPAIRS AND IMPROVEMENTS OF HOSPITALS.

The expenditure under this head for the last fiscal year amounted to \$20,000 against \$25,000 in 1873 and 1874, each. In consequence of the small amount thus available, repairs have been limited with strictness to objects of absolute necessity, primarily to those required for the protection of the buildings from the destructive action of the elements. Nothing has been expended for embellishment or mere looks. The appropriation for the current fiscal year is just half the amount appropriated for the year before, and will scarcely suffice to keep the hospitals in tenantable order.

In consequence of the meagerness of the sums at the disposal of the bureau during the last two years, the hospitals, with their heating apparatus, outbuildings, fences, roadways, wharves, cemeteries, &c., are now in need of extensive reparation, to meet which, as well as provide for ordinary repairs, the amount asked for during the next fiscal year is submitted.

## HOSPITAL AT PENSACOLA, FLA.

Since my last annual report, the hospital specially constructed near the navy-yard, Pensacola, for the reception of yellow-fever patients, has been plainly furnished, and is now in readiness for the accommodation of such cases. Owing, fortunately, to an exceptional freedom from the disease on the Gulf coast during the present season, its conveniences and comforts have not been tested, except for the treatment of ordinary maladies. Lengthened immunity from this dreaded visitant cannot be expected, but on its next invasion it will be satisfactory to know that our hospital arrangements are ample for any demands likely to be made upon them.

## NAVAL-HOSPITAL FUND.

I desire again to bring the condition of the naval-hospital fund to your notice. The fact stated in my last annual report that it may be considered virtually exhausted still remains. As the support of our various establishments for the care of the sick depends upon this fund, the importance of speedily placing it on a permanent foundation is sufficiently obvious.

The cost of the provisions, medicines, medical stores, fuel, &c., consumed in the naval hospitals and chargeable to this fund, amounts to about \$135,000 a year; of which sum \$35,000 are realized from "hospital money" and "stopped rations" of the sick, leaving an annual deficiency of \$100,000, which must sooner or later be supplied by special legislation. I therefore earnestly request your approval of an appropriation by Congress of the sum named, viz, \$100,000, and of a regular annual appropriation of the same amount for the future.

If the replenishing of the naval-hospital fund by specific appropriation be deemed inexpedient, the object may be accomplished in a more indirect, but, in my opinion, equally legal manner, by transferring to it by permanent act a portion of the income of the naval-pension fund. Should this fund, which is now invested in Government bonds bearing only 3 per cent. interest, be re-invested at 6 per cent., its income would not only meet all charges for pension, but leave a balance of several hundred thousand dollars, out of which the sum required might be set aside for the benefit of the congenious naval-hospital fund. In either case the result to the Treasury of the United States would be the same: but the latter mode, by rendering an annual appropriation unnecessary.

would possess the advantage of conferring a much-needed stability on the hospital service.

#### HEALTH OF THE NAVY.

During the past year the health of the Navy has come up to the usual standard. No epidemic or pestilential disease has prevailed on any of the stations, and in the main the experience of the year must be regarded as satisfactory. But good as these results are, better may be expected when a better system of ventilation and a greater degree of dryness shall obtain on board of our cruising vessels. From the frequent reports made to the bureau by surgeons of the foul state of the bilges of some of our ships, and the almost insuperable difficulty of keeping them in a wholesome condition, I am satisfied much remains to be achieved in naval construction before this evil (which is an undoubted source of disease) shall be remedied. If, with a view to the improvement of the ventilation of holds and berth-decks, a thorough investigation of the whole subject could be made by a joint board of line, construction and medical officers, it can hardly be doubted that the result would be a great advance on the present system of ventilation, which so often proved delusive, and might probably lead to the suggestion of practical means for the more effectual cleansing of bilges than can apparently be done under the existing arrangement. The health of those living in ships depends so closely on the cleanliness of this part of the interior and the rapid elimination by good ventilation of the noxious gases generated there, that the desirableness of an amelioration in these respects must be obvious to all.

Another important factor in maintaining an elevated standard of health among the crews of naval vessels is the dryness of the atmosphere they breathe and of the apartments—notably the berth-deck—where they habitually live. With naval medical men of all nations it has passed into an axiom that a dry ship is a healthy ship. The action of a humid atmosphere, with sudden fluctuations of temperature, especially from a higher to a lower degree, in causing and intensifying many kinds of disease, is almost as well known to the intelligent public as to physicians in extensive practice. At sea these agencies are more actively at work than on land, and for the greater part of his life the sailor is more or less exposed to their influence.

Although it is not pretended that all acute diseases occurring on ship-board originate from dampness, no medical officer is ignorant of the fact that a large proportion of the preventable or avoidable maladies prevailing among sea-faring men are directly traceable to this condition of the decks and atmosphere of ships. The deluging of berth-decks with water for purposes of cleanliness or to produce a neat appearance, once so common in the Navy, and still practiced in some exceptional instances, has long been recognized by medical officers as highly deleterious to the health as well as the comfort of the men living and sleeping on them; and not only by them, but also, in many cases, by judicious commanding officers, who, once convinced of the evils of the practice, have promptly put a stop to it.

How abnormally damp the interior of a man-of-war may become is shown by recent hygrometric observations on board one of our larger ships cruising in a warm climate, where the medical officer, a man of scientific attainments and large naval experience, ascertained that the air of the berth-deck for a lengthened period was constantly on the verge of saturation, *i. e.*, on the point of depositing its moisture, or, in other

words, raining; and this notwithstanding steam was used for its drying properties on, as well as below, the berth-deck some 203 out of 311 days. The assumed necessity for resorting to this use of artificial heat (a portion of the time in an almost tropical region) demonstrates the presence of an extraordinary amount of humidity. How much of this was owing to natural and how much to avoidable causes is a problem not easy of solution, but the fact that the berth-deck in question during the term of these observations had been wet once in about every thirty hours, raises a reasonable suspicion that it was not altogether the result of natural agencies.

The order of the Department issued early in the present year revoking a former order, which forbade the covering of berth-decks with shellac, will remove a portion of this source of disease in cases where the inordinate use of water may still prevail, and by securing dryness in the quarters occupied by the men, cannot fail to prove to them a boon of no inconsiderable value.

#### SURGEON'S QUARTERS AT MARE ISLAND HOSPITAL.

Among the estimates herewith submitted is one for the erection of a house for the medical officer in charge of the naval hospital at Mare Island, Cal. At present this officer has to seek quarters for himself and family in the hospital. With the increasing demand for space to accommodate patients, this arrangement is beginning to occasion great inconvenience.

The want of a house has been felt for a number of years, and estimates have heretofore been submitted, but without result. It is believed the period has at length arrived when the work can no longer be delayed. Separate quarters for the senior surgeon exist at all the other principal hospitals, and the necessity for their erection at this establishment is the greater because there are no private houses near it which the surgeon could hire.

#### LIBRARIES AT NAVAL HOSPITALS.

I beg leave to renew a former recommendation, that a small appropriation be granted for the purchase of books for use at the principal naval hospitals, which, at present, are quite destitute of these invaluable aids in the care of the sick.

This want, it is assumed, needs but to be mentioned to commend itself to the favorable consideration of the law-making power.

#### BUREAU PUBLICATIONS.

The Surgical History of the Navy, spoken of in my report of 1874 as then rapidly approaching completion, was in such a state of forwardness at the last session of Congress as to justify the hope that authority would be given for the publication, at least, of the first volume. Disappointed in that expectation, the bureau now earnestly renews its recommendation that this valuable collection of facts, embracing, in addition to other years, the entire period of the civil war, shall no longer be withheld from the medical profession. It is a modest effort to do for the Navy what the Surgical History of the Rebellion, published under the auspices of the War Department, has done for the Army, and, though not intended to vie with that unrivaled publication, will be a work of the like scope and comprehensiveness.



The only publication by the bureau since the issue of its last annual report was a volume of "Sanitary and Medical Reports for 1873-'74." This work has been received with gratifying favor by the public, both professional and otherwise, and contains so much useful information that it is hoped a similar volume may be issued every year.

## NAVAL MEDICAL SCHOOL.

The project of establishing, on a very moderate scale, a school for the instruction of assistant surgeons in certain practical branches of their profession, was presented in my annual reports of 1873 and 1874. The views then expressed of the benefits it would confer on the younger members of the corps, having been strengthened by further reflection, the subject is again commended to your favorable consideration.

Very respectfully, your obedient servant,

J. BEALE,

*Surgeon-General United States Navy.*

Hon. GEO. M. ROBESON,

*Secretary of the Navy.*

A.—Annual statement compiled from sick-reports from naval stations and vessels in commission on home and foreign service for the year ending December 31, 1875.

Hospitals.	Remaining sick December 31, 1874.	Admitted in 1875.	Discharged in 1875.	Died in 1875.	Total treated in 1875.	Remaining sick December 31, 1875.	Percentage of deaths to whole number treated.
Chelsea, Mass.....	18	38	46	4	56	6	.....
Brooklyn, N. Y.....	39	299	282	13	332	43	.....
Philadelphia, Pa.....	19	179	144	19	198	35	.....
Annapolis, Md.....	5	30	31	.....	35	4	.....
Washington, D. C.....	21	63	61	4	84	19	.....
Norfolk, Va.....	19	169	156	5	168	27	.....
Pensacola, Fla.....	5	37	34	6	42	2	.....
Mare Island, Cal.....	61	101	114	5	162	43	.....
Yokohama, Japan.....	13	63	56	5	76	15	.....
Total.....	200	979	924	61	1,179	194	.05

Yards and stations.	Remaining December 31, 1874.	Admitted in 1875.	Discharged in 1875.	Died in 1875.	Total treated in 1875.	Remaining December 31, 1875.	Percentage of deaths to whole number treated.
Portsmouth, N. H.....	9	102	102	3	111	6	.....
Boston, Mass.....	3	92	94	1	95	.....	.....
Brooklyn, N. Y.....	7	233	232	1	240	7	.....
Philadelphia, Pa.....	1	249	248	.....	250	2	.....
League Island, Pa.....	1	20	19	.....	21	2	.....
Washington, D. C.....	6	193	198	.....	199	1	.....
Norfolk, Va.....	1	94	93	1	95	1	.....
Pensacola, Fla.....	.....	59	57	1	59	1	.....
Mare Island, Cal.....	2	76	75	.....	78	3	.....
Torpedo-station.....	1	51	50	1	52	1	.....
Naval Academy.....	7	974	955	3	981	23	.....
Total.....	38	2,143	2,123	11	2,181	47	0.005

## A.—Annual statement compiled from sick-reports, &amp;c.—Continued.

Receiving-ships.	Average number on board in 1875.	Remaining December 31, 1874.	Admitted in 1875.	Discharged in 1875.	Died in 1875.	Total treated in 1875.	Remaining December 31, 1875.	Percentage of deaths to whole number of cases treated.
Portsmouth, N. H. ....	206	78	74	9	78			
Boston, Mass. ....	252	108	100	1	108			
Brooklyn, N. Y. ....	569	144	143	1	147			
Philadelphia, Pa. ....	120	69	69		72			
Norfolk, Va. ....	273	30	29		35			
Mare Island, Cal. ....	114	25	20		25			
Total .....	1,534	36	499	499	4	525	28	0.34

## Summary of vessels in commission.

Average number of persons on board during year 1875.....	10.16
Remaining sick December 31, 1874 .....	512
Admitted in 1875.....	11,205
Discharged in 1875 .....	11,107
Died in 1875.....	125
Total treated in 1875 .....	11,232
Remaining sick December 31, 1875 .....	11,675
Percentage of cases to whole number on board.....	0.01
Percentage of deaths to whole number on board .....	0.01
Percentage of deaths to whole number of cases treated.....	0.01

## RECAPITULATION.

	Aggregate number of officers and men on board of vessels in 1875.	Remaining sick December 31, 1874.	Admitted in 1875.	Discharged in 1875.	Died in 1875.	Total treated in 1875.	Remaining sick December 31, 1875.	Percentage of cases to number of persons on board.	Percentage of deaths to number of persons on board.	Percentage of deaths to number of persons treated.
Hospitals .....	200	979	924	61	1,179	194				
Yards and stations .....	38	2,143	2,123	11	2,181	47				
Receiving-ships .....	1,534	36	499	499	4	525		0.30	0.004	
Vessels in commission at sea.....	10,141	238	7,594	7,561	49	7,832	222	0.70	0.004	
Total .....	11,675	512	11,205	11,107	125	11,717	483	1.01	0.01	0.01

At the close of the year 1874 there remained under treatment 512 cases; during the year 1875 there occurred 11,205 cases of disease, injury, &c., making a total of 11,717 cases treated during the year; of which number 125 died, 11,107 were returned to duty or discharged the service, leaving 483 cases under treatment at the close of the year 1875.

The average strength of the Navy (officers, seamen, marines, engineer-service, and Coast Survey included) for the year 1875, as near as can be ascertained, was about 11,675.

The percentage of cases admitted to the whole number of persons in the service was about 1.01, or each person was on the sick-list 1.01 times during the year. The percentage of deaths to the whole number of persons in the service was 0.01, and the percentage of deaths to the whole number of cases treated was 0.01.

The total number of deaths from all causes, reported at the Navy Department from October 1, 1875, to September 30, 1876, was 118.

	North Atlantic.	South Atlantic.	European.	Pacific.	Anatic.	Special service.	School and practice.	Coast survey.	Total.
Aggregate number of men .....	3, 489.	1, 194.	1, 182.	1, 762.	1, 489.	560.	400.	115.	10, 141.
	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.	Cases treated. Deaths.
<b>Class I.—Zymotic diseases :</b>									
Order I.—Miasmatic diseases :									
Catarrhus epidemica . . . . .	6			3	6		15		30
Cholera epidemicæ . . . . .				4	4				4
Cynanche parotidea . . . . .	5			1	5	1			9
Dysentery . . . . .									
Erysipelas . . . . .	1								1
Febbris cerebro-spinalis . . . . .	3		6	4	4				17
Febbris continua simplex . . . . .									1
Febbris entericæ . . . . .	34	8	33	19	3				98
Febris flava . . . . .	9	2	4	2	1				20
Febbris intermittens . . . . .	2	24	6						26
Febbris remittens . . . . .	215	21	42	153	106	36	11	6	590
Febbris typhus . . . . .									
Morbilli . . . . .	58	2	4	4	34	2	1	1	105
Pertussis . . . . .									1
Rubeola . . . . .					1				
Typha . . . . .									
Varioloides . . . . .									
Vaccinia . . . . .									
<b>Order II.—Enthetic diseases :</b>									
Syphilis primitiva . . . . .	108	44	56	57	70	5	2	6	350
Syphilis consecutiva . . . . .	23	15	14	27	58	3	1	9	150
Gonorrhœa . . . . .	53	24	37	74	32	3	3	10	236
Ophthalmia gonorrhœica . . . . .					1				1

B.—Summary of prevalent forms of disease on home and foreign service for the year ending December 31, 1875—Continued.

	North Atlantic.		South Atlantic.		European.		Pacific.		Asiatic.		Special service.		School and practice.		Coast survey.		Total.	
	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.
Class I.—Zymotic diseases—Continued.																		
Order III.—Diabetic diseases:																		
Alcoholismus.....	17	.....	9	.....	8	.....	23	.....	9	.....	11	.....	4	.....	.....	.....	81	.....
Delirium tremens.....	4	.....	.....	.....	.....	.....	1	.....	2	.....	.....	.....	1	.....	.....	.....	8	.....
Epididymitis.....	3	.....	.....	.....	.....	.....	.....	.....	1	.....	2	.....	.....	.....	.....	.....	7	.....
Erysipelas.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Furunculosis.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Scrophulous diseases:																		
Order I.—Constitutional diseases:																		
Order I.—Diabetic diseases:																		
Adynamia.....	54	.....	15	.....	.....	.....	10	.....	22	.....	2	.....	.....	.....	.....	.....	103	.....
Anemia.....	4	.....	2	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	8	.....
Carcinoma.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Gangrena senilis.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hydrops.....	1	.....	.....	.....	.....	.....	9	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Podagra.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rheumatismus acutus.....	67	.....	20	.....	13	.....	56	.....	21	.....	14	.....	.....	.....	1	.....	102	.....
Rheumatismus chronicus.....	95	.....	51	.....	49	.....	55	.....	64	.....	14	.....	3	.....	2	.....	333	.....
Rheumatismus gonorrhoeicus.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rheumatic gout.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Rheumatismus gonorrhoeicus.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Order II.—Developmental diseases:																		
Atrophia.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Degeneratio.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hypertrophia.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Senectus.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Articula.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Anasarca.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Order III.—Tubercular diseases:																		
Scrophula.....	4	.....	.....	.....	3	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	7	.....
Tuberculosis.....	4	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	.....
Order IV.—Parasitic diseases:																		
Scabies.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Vermes.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dracunculus.....	3	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Order I.—Local diseases:																		
Order I.—Diseases of the nervous system:																		
Atrophica.....	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[illegible]

B.—Summary of prevalent forms of disease on home and foreign service for the year ending December 31, 1875—Continued.

	North Atlantic		South Atlantic		European.		Pacific.		Asiatic.		Special service.		School and practice.		Coast survey.		Total.	
	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.
<b>Class IV.—Local diseases—Continued.</b>																		
<b>Order VI.—Diseases of the respiratory system:</b>																		
Apnoea.....													1				1	
Asthma.....	8		29		2		2				1						13	
Bronchitis acuta.....	65		23		11		24		52		26		4		8		219	
Bronchitis chronica.....	23		9		2		19		3		1		2				59	
Catarrhus.....	67		11		47		45		53		8		9		5		245	
Epistaxis.....	1						1										2	
Hydrothorax.....																		
Laryngitis.....	2		4		1		1		2								10	
Phthisis pneumonia acuta.....	10		2		4		2		2				2		1		20	
Phthisis pneumonia chronica.....	15		3		1		7		12		4		7				56	
Pleuritis.....	12		7		7		9		9		7						51	
Pneumonia.....	13		3		2		6		5						1		30	
Hamoptysis.....	2		1				3		1		1						7	
Pertussis.....	1																1	
Pleuro-pneumonia.....	1																1	
Pleuritis.....																	3	
Pleuritis.....							2		1									
<b>Order VII.—Diseases of the digestive system:</b>																		
Aciditas.....					2												9	
Cholera morbus.....	26		5		13		64		5		3		10		5		131	
Cirrhosis hepatis.....																	1	
Colica.....	32		20		3		14		26		4		8				109	
Constipatio.....	14		10		5		8		217		6		15		9		67	
Diarrhoea acuta.....	106		23		37		86		5		40		24		10		542	
Diarrhoea chronica.....	14		3		1		5		15		1		3				43	
Dysenteria acuta.....	30		11		6		27		43		7		8		21		153	
Dysenteria chronica.....	5				1		10		4								20	
Dyspepsia.....	28		10		2		11		9		3		18				81	
Etiaritis.....																		
Flatulencia auto.....	4		1		1		4		2								19	
Flatulencia.....	7		9				6				3						14	
Flatulencia.....							1										3	
Flatulencia.....			5		4		13		10		3						62	
Flatulencia.....																	7	

Peritonitis.....	1	2	7	2	2	7	1	1	3	1	1	3	29
Pharyngitis.....	7	2	1	1	1	1	1	1	1	1	1	1	23
Proctitis.....	2	1	1	1	1	1	1	1	1	1	1	1	2
Splinitis.....	1	1	1	1	1	1	1	1	1	1	1	1	2
Stomatitis.....	2	1	1	1	1	1	1	1	1	1	1	1	15
Tonsillitis.....	41	22	15	15	15	15	15	15	11	4	1	1	118
Trauma in ano.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Nausea.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Order VIII.—Diseases of the urinary and genital system:													
Albuminuria.....	2	1	1	1	1	1	1	1	1	1	1	1	3
Calculus.....	7	1	1	1	1	1	1	1	1	1	1	1	4
Cystitis.....	1	1	1	1	1	1	1	1	1	1	1	1	14
Diabetes.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Dysuria.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Hæmaturia.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Nephritis.....	27	11	22	22	22	22	22	22	2	2	2	2	147
Orchitis.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Paraphimosis.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Phymosis.....	2	1	1	1	1	1	1	1	1	1	1	1	12
Enuresis.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Fistula vesicæ.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Hæmaturia.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Hydrocele.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Spermatorrhœa.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Urethra strictura.....	5	7	6	6	6	6	6	6	2	2	2	2	6
Varicocele.....	2	1	1	1	1	1	1	1	1	1	1	1	32
Order IX.—Diseases of the locomotive system:													
Arthritis.....	2	1	1	1	1	1	1	1	1	1	1	1	8
Anchylolosis.....	1	1	1	1	1	1	1	1	1	1	1	1	4
Caries.....	1	1	1	1	1	1	1	1	1	1	1	1	3
Coxalgia.....	1	1	1	1	1	1	1	1	1	1	1	1	3
Hydrops articuli.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Necrosis.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Ostitis.....	3	1	1	1	1	1	1	1	1	1	1	1	14
Periostitis.....	6	2	2	2	2	2	2	2	3	3	3	3	14
Synovitis.....	2	1	1	1	1	1	1	1	1	1	1	1	2
Myalgia.....	2	1	1	1	1	1	1	1	1	1	1	1	2
Plegmon.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Anasarca.....	1	1	1	1	1	1	1	1	1	1	1	1	1
Order X.—Diseases of the integumentary system:													
Acne.....	64	23	18	47	39	39	39	39	3	7	1	1	203
Acne.....	2	1	1	1	1	1	1	1	1	1	1	1	3
Adenitis.....	33	15	18	28	30	30	30	5	5	1	1	1	130
Anthrax.....	6	1	1	1	1	1	1	1	1	1	1	1	18
Ecthyma.....	2	1	1	1	1	1	1	1	1	1	1	1	5
Eczema.....	10	1	1	1	1	1	1	1	1	1	1	1	16
Erythema.....	1	1	1	1	1	1	1	1	1	1	1	1	3
Furunculæ.....	82	27	36	68	67	67	67	3	3	2	7	7	293
Herpes.....	4	1	1	1	1	1	1	1	1	1	1	1	9
Impetigo.....	1	1	1	1	1	1	1	1	1	1	1	1	6

## B.—Summary of prevalent forms of disease on home and foreign service for the year ending December 31, 1875—Continued.

	North Atlantic.		South Atlantic.		European.		Pacific.		Asiatic.		Special service.		School and practice.		Coast survey.		Total.	
	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.	Cases treated.	Deaths.
Class IV.—Local diseases—Continued.																		
Order X.—Diseases of the integumentary system—Cont'd.																		
Leprosy.....	1						1										1	
Lichen.....	33		10		6		29		10								4	
Paronychia.....									3								3	
Pemphigus.....	9								2								11	
Pempho.....	1																1	
Porigo.....																		
Prurigo.....					1		1											
Scorbutus.....	1						2										3	
Syphilis.....	2				1		1		4		1		1				3	
Unguis involutus.....	1		6														1	
Ulcus.....	1																	
Unguis avulsio.....	2								2								1	
Urticaria.....																		
Pyrimis rubra.....					1												1	
Class V.—Non-malignant tumors and cysts:																		
Adenoma.....							4		1								5	
Angeloma.....					2								2				5	
Cystis sebacea.....			1				1										1	
Endochondroma.....																		
Fibroma.....																	1	
Lipoma.....					1												1	
Neuroma.....																	1	
Osteoma.....	1						1										1	
Polypus.....																	1	
Sarcoma.....							1										1	
Coudeloma.....																		
Class VI.—Violent diseases and deaths:																		
Order I.—Wounds, injuries, and accidents:																		
Abrasio.....	29	8	14		14		14		11		3		7				76	1
Amblyo.....	10	7	9		9		19		5		4		4				60	1
Compendio ceratral.....	2	1	30		30		30		4								30	2
Conducto.....	104	30	61		61		76		6		25		30		4		307	9
Capitulum.....																	4	



[illegible]

## C.

*Naval-hospital fund.*

The condition of this fund is represented as follows:

Balance on hand October 1, 1875.....	\$2,134 65
Transferred to the credit of the fund, in settlement of accounts, by the Fourth Auditor, from October 1, 1875, to October 1, 1876 .....	31,646 92
Total .....	33,781 57
Deduct amounts expended from October 1, 1875, to October 1, 1876.....	32,946 67
Balance on hand October 1, 1876 .....	834 90

## D.

*Insane of the Navy.*

On the 30th September, 1875, there remained under treatment in the Government Hospital for the Insane, near this city: 4 officers; 1 late ensign; 10 seamen; 3 ordinary seamen; 1 seaman, (engineer force; 3 ordinary seamen, extra; 1 late seaman; 11 landsmen; 1 late landsman; 1 coal-heaver; 9 marines; and 3 beneficiaries—total .....	45
Admitted during the year ending September 30, 1876: 2 officers; 2 seamen; 1 seaman, extra; 2 landsmen; 2 beneficiaries—total .....	9
Total number under treatment during the year .....	54
The discharges in the course of the year were—	
By recovery or improvement:	
1 seaman, (engineer force; 2 ordinary seamen; 1 landsman—total.....	4
By death:	
1 seaman; 1 landsman; 1 marine; 2 beneficiaries .....	5
Leaving in the institution on the 30th September, 1876: 6 officers; 1 late ensign; 11 seamen; 1 ordinary seaman; 3 ordinary seamen, extra; 1 seaman, extra; 1 late seaman; 11 landsmen; 1 late landsman; 1 coal-heaver; 8 marines; and 3 beneficiaries—total .....	45

## No. 8.—BUREAU OF PROVISIONS AND CLOTHING.

NAVY DEPARTMENT,  
BUREAU OF PROVISIONS AND CLOTHING,  
November 8, 1876.

SIR: I have the honor to submit herewith estimates, marked A, B, C, D, and E, for the fiscal year ending June 30, 1878.

The bureau takes this opportunity to renew its recommendation of last year, that appointments to the Paymasters' Corps of the Navy be made from graduates of the Naval Academy at Annapolis, as it is the opinion of the bureau, strengthened by the favorable results produced by the appointments to the Engineer Corps of the Navy under the new system, that the proposed change would tend to promote unity of feeling between line and staff officers and add materially to the efficiency of the naval service.

I have the honor to be, very respectfully, &c.,

JAS. H. WATMOUGH,

*Acting Paymaster-General, United States Navy.*

HON. GEO. M. ROBESON,

*Secretary of the Navy.*

*Estimates of appropriations for the service of the fiscal year ending June 30, 1878, by the Bureau of Provisions and Clothing.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>A.—Expenses of the Bureau of Provisions and Clothing.</b>		
For salary of chief clerk, per act of July 5, 1862, (12 Stat. at L., p. 511, sec. 3)....	\$1,800 00	
For salary of one clerk of class four, per act of July 23, 1866, (14 Stat. at L., p. 208, sec. 8).....	1,800 00	
For salary of three clerks of class three, per act of July 23, 1866, (14 Stat. at L., p. 208, sec. 8)*.....	4,800 00	
For salary of two clerks of class two, per act of July 23, 1866, (14 Stat. at L., p. 208, sec. 8).....	2,800 00	
For salary of three clerks of class one, per act of July 23, 1866, (14 Stat. at L., p. 208, sec. 8).....	3,600 00	
For salary of messenger, per act of July 5, 1862, (12 Stat. at L., p. 511, sec. 3)....	840 00	
For salary of one laborer, per act of July 12, 1870, (16 Stat. at L., p. 250, sec. 3) ..	720 00	
	16,360 00	\$14,760 00
<b>B.—Contingent expenses of the Bureau.</b>		
For blank-books, stationery, and miscellaneous items, (appropriated,) (18 Stat. at L., p. 363) .....	800 00	400 00
<b>C.—Provisions for the Navy.</b>		
To pay 1,065 officers for commuted rations; being on duty and entitled to the same, at 30 cents per day.....	116,617 50	
To pay 1,500 men for commuted rations; being one-fifth of the number of men allowed, at 30 cents per day.....	164,250 00	
For the purchase of rations for 6,000 men; being four-fifths of the number of men allowed, at 30 cents per day.....	657,000 00	
For 10 per cent. on above amount for waste in handling and issuing provisions, and loss from condemnation.....	65,700 00	
To pay 203 marines for commuted rations; being one-fifth of the number on duty entitling them to a ration, at 30 cents per day.....	22,226 50	
For the purchase of rations for 813 marines; being four-fifths of the number on duty entitling them to a ration, at 30 cents per day.....	89,023 50	

\* The estimate for an additional clerk of class three (allowed by act of July 23, 1866) is submitted on account of the Department's order of July 21, 1873, requiring the accounts of all pay-officers to be settled quarterly instead of at the end of a cruise.

*Estimates of appropriations for the service, &c.—Continued.*

Detailed objects of expenditures, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>C.—Provisions for the Navy—Continued.</b>		
For 10 per cent. on above amount for waste in handling and issuing provisions, and loss from condemnation .....	\$8,908 35	
To pay expenses of nine inspections in the United States, including labor, and three store-houses abroad, including labor and rent .....	100,000 00	
For the purchase of water for ships, (appropriated,) (18 Stat. at L., p. 300).....	30,000 00	
	<b>1,253,731 85</b>	<b>\$955,000 00</b>
<b>D.—Contingent expenses of the Navy under Bureau of Provisions and Clothing.</b>		
For freight-charges on shipment .....	35,000 00	
For candles .....	25,000 00	
For fuel .....	1,000 00	
For books and blanks .....	1,000 00	
For stationery .....	9,000 00	
For advertising and commissions on sales .....	1,500 00	
For postage, telegrams, and express-charges .....	500 00	
For yeoman's stores .....	2,000 00	
	<b>75,000 00</b>	<b>35,000 00</b>
<p>NOTE.—Prior to the fiscal year 1874-'75 the annual appropriation under contingent, Bureau of Provisions and Clothing, was \$75,000, and it is found by experience that a smaller sum than the above estimate is inadequate to the wants of the service. The above estimates are based upon the actual expenditures for the last fiscal year.</p>		
<b>E.—Clothing and clothing materials for the Navy.</b>		
For the purchase of clothing and clothing materials, (submitted) .....	150,000 00	150,000 00
<p>NOTE.—The appropriation "Pay of the Navy" having been for the last two years insufficient to admit of the necessary quarterly transfers to the "clothing fund," and the said fund being nearly exhausted, the appropriation of \$150,000 becomes necessary for the requirements of the service for the next fiscal year.</p>		

## No. 9.—BUREAU OF STEAM-ENGINEERING.

NAVY DEPARTMENT,  
BUREAU OF STEAM-ENGINEERING,  
*Washington, October 30, 1876.*

SIR: I have the honor respectfully to submit the annual report of this bureau, with estimates for the preservation, construction, and repairs of the machinery of naval steamers at the several yards and stations; for the necessary stores, labor, materials, &c., required in fitting out and maintaining in efficient condition the machinery of steamers cruising on foreign stations, heating and ventilating apparatus, &c., and for incidental purposes under the cognizance of this bureau.

The following lists specify character and extent of work done by this bureau in refitting the machinery of naval steamers during the past year for active service. They show also their present condition, and the work necessary to further repair and refit such as are required for service at sea, &c.

Colorado, (first rate.) New boilers are being constructed at the Delamater Iron-Works, New York, and are nearly completed; there remains to be done, to place the machinery of the Colorado in an efficient condition for service, the erection of the new boilers on board, with all necessary connections and a general overhauling of the engines and their dependencies.

Franklin, (first rate.) Some repairs to the machinery of the Franklin were made at the government dock-yard at Spezia, Italy, during her present cruise, now about its termination. The boilers are reported unreliable, and should be replaced by new ones. The machinery requires the usual overhauling and repairs incidental to that of all vessels at the expiration of their cruises.

Wabash, (first rate.) This vessel requires new boilers and machinery. The machinery of the following vessels requires overhauling and repairs to place it in proper condition for continued active cruising: Brooklyn, (second rate,) Richmond, (second rate,) and Omaha, (second rate.)

New boilers have been completed for the Juniata, (third rate,) and are ready for erection and connection with the machinery on board, which requires very extensive repairs.

Boilers, partially completed, are being constructed for the following-named vessels: Wachusett, (third rate,) Alaska, (second rate,) Benicia, (second rate,) Shenandoah, (second rate,) Puritan, (second rate, iron-clad,) Amphitrite, (third rate, iron-clad,) Monadnock, (third rate, iron-clad,) Terror, (third rate, iron-clad.)

New machinery and boilers for the Miantonomoh (third rate, double-turreted twin-screw iron-clad) are well advanced toward completion.

The machinery of the following vessels is undergoing repairs of greater or less extent at the stations named, (those marked \* have new boilers:) Swatara, (third rate,) navy-yard, New York; Iroquois,\* (third rate,) Mare Island, Cal.; Tuscarora, (third rate,) Mare Island, Cal.; Wyoming,\* (third rate,) navy-yard, Washington, D. C.; Canandaigua, (second rate,) navy-yard, Norfolk, Va.; and Comanche, (fourth rate, iron-clad.)

The machinery of the steamer Gettysburg has been recently repaired at the navy-yard, Washington, and the vessel is now in active service at sea.

On the Asiatic station, new boilers have been erected on board the Ashuelot, (third rate,) Monocacy, (third rate,) and Palos, (fourth rate,) and the machinery of these vessels placed in thorough and efficient re-

pair for continued active cruising. The usual repairs required by the vessels of the smaller class—tugs, steam-launches, &c.—have been made, (and in some cases requiring new boilers and machinery,) so far as the means at the disposition of this bureau permitted.

New boilers should be constructed for the Omaha, (second rate,) Hartford, (second rate,) Narragansett, (third rate,) Yantic, (third rate,) and Saco, (third rate.) New machinery is being constructed at the navy-yards, at Norfolk, Va., and Mare Island, Cal., for the Mohican and Galena. But little progress has been made during the present fiscal year toward its completion. New machinery for the Trenton, (second rate,) constructed by John Roach & Son, Morgan Iron-Works, New York, has been erected on board that vessel, and a very satisfactory preliminary trial at the dock has been had. The vessel is now being fitted out for sea-service at the navy-yard, New York, and a thorough trial of the machinery (which is of the compound type) will be made prior to her departure from the United States. Quinnebaug, (third rate,) The new compound machinery for this vessel (converted from simple to compound at the navy-yard, New York, and erected under contract with Messrs. Neafe & Levy, of Philadelphia, Pa.) is about ready for a steam-trial and fitting out for sea-service. Vandalia, (third rate.) The machinery converted from the simple to the compound type at the navy-yard, Boston, Mass., has been erected on board the vessel, and a satisfactory trial of it has been had; she is now performing efficient service at sea. Marion, (third rate.) The machinery, also converted into the compound from the simple type, is completed on board the vessel, has been thoroughly tested, and is now performing satisfactory service at sea. Enterprise, (third rate.) The new compound engines constructed by the Woodruff Iron-Works, at Hartford, Conn., are completed and erected on board the vessel. A satisfactory contract-trial has been had, and the machinery is reported ready for service. In my last report I had the honor to call your attention to the necessity of erecting engines on board the twin-screw double-turreted monitors, Amphitrite, Terror, and Monadnock. In this respect nothing has been done except to place under contract the boilers for these vessels, as previously reported, that they might be placed in the holds of the vessels prior to putting on the iron decks, beams, and plates, a necessity arising from there being no permanent openings in the decks large enough to admit them into the holds of the vessels after the completion of the latter, then under contract by the Bureau of Construction. Drawings and specifications of the engines have been prepared, but no contracts made for the machinery, which should be placed under contract without further delay, that the services of these monitors may be available on the completion of the hulls, which are well advanced.

#### SCREW-SLOOP LANCASTER.

New boilers have been completed for this vessel by the Providence Steam-Engine Company. As our vessels, when cruising abroad, burn more bituminous coal than anthracite the boilers have been designed with that view. I believe they will burn bituminous coal better than any we have at present, and will burn anthracite equally well. They will permit a high rate of combustion, and will develop greater power in proportion to the space occupied than the boilers they will replace. The engines, built in 1859, and in almost constant use ever since, are now about worn out, and not worth repairs. They should be removed and replaced by others; and I would suggest for this purpose the engines at

the Worcester, which are in good condition. Though not of the most improved type, these engines are of a later and better design than the present machinery of the Lancaster, and, with the new boilers, and a new screw-propeller of greater diameter and area of propelling surface, already designed, will nearly double the engine-power of the vessel, and her speed against a head wind and sea will be greatly increased. The boilers are designed to carry forty (40) pounds pressure above the atmosphere, and it is calculated that 1,600 indicated horses-power will be developed when the steam is cut off at one-fourth of the stroke of the piston. The range of expansion will be from one-fourth to six-tenths, and with the link in full gear, nearly the full power may be developed with a boiler-pressure of seventeen pounds above the atmosphere. This will give the vessel a good speed during the whole life-time of the boilers.

*Dimensions of the machinery.*

	Original machinery.	New machinery.
<b>ENGINES.</b>		
Number of cylinders.....	2	2
Diameter of cylinders, in inches.....	61	60
Stroke of pistons, in feet and inches.....	2' 9"	3'
Kind of condensers.....	Jet.....	Surface.
Revolutions per minute.....	44	60*
Indicated horses-power developed by engines.....	810	1,600*
Speed, in nautical miles, per hour.....	9.5	11*
Length of engines, fore and aft, in feet and inches.....	19' 1"	21' 3"
Width of engines, athwartship, in feet and inches.....	24' 1"	19' 3"
<b>SCREWS.</b>		
Diameter, in feet and inches.....	15' 6"	17'
Pitch, in feet and inches.....	24' 9"	21' 3"
Length, on line of keel, in inches.....	36"	31 7-8"
Helicoidal area, in square feet.....	58.28	132

	<b>KIND OF BOILER.</b>		
	Original.	Present.	New.
	Martin's vertical tubular.	Martin's vertical tubular.	Horizontal tubular.
Total area of grate surface, in square feet.....	294	351	336
Total area of heating-surface, in square feet.....	9,040	9,606	9,397
Ratio of grate to heating surface.....	30.7	27	26
Barometer.....	1.7	1.7	1.6
Number of boilers.....	4	4	4
Length over the boilers, fore and aft, in feet and inches.....	20' 6"	33'	29' 6"

	Original arrangement.	Present arrangement.	New arrangement.
Length occupied in the vessel, by all machinery, in feet and inches.....	56' 6"	59' 9"	59' 6"

\* Calculated.

**CHANGE OF SCREWS.**

Since the date of my last report no further opportunity has been had of replacing the original screws of four blades and removing the inefficient two-bladed screws with which a very large number of our naval teamers were fitted in the year 1869, to which change their loss of

speed when steaming was more attributable than perhaps to any other cause. To show the great superiority in efficiency and economy of the original over the substituted screws, I submit the following tables. They contain all the necessary data connected with the change of screws as recorded in the steam-logs of the vessels, including the cost of making and fitting the new screws, as far as could be ascertained, the loss in speed and waste of coal consequent to the increased percentage of slip incident to the use of the two-bladed screws of insufficient area, as previously reported. The total number of pounds of coal that would have been burned had the original screws not been removed, is calculated on the assumption that the vessels would have been run the same distances, at the same speeds, as they actually were run with the substituted screws, and the computation determines the coal wasted at those speeds and distances.



TABLE I.—Showing the kind, dimensions, weight, cost, and final disposition of screw-propellers that were made and substituted for the original screws.

Name of vessel.	Name of the patentee.	Dimensions of the screw.				Where made.	Where fitted.	Of what material.	Finished weight in pounds.	Cost of making.	Cost of fitting.	Final disposition of the two-bladed screws.
		Number of blades.	Diameter in ft.	Mean pitch in ft. and in.	Length in inches.							
Savannah	Mangin	4	17	32	43	Washington	New York	Composition	12,030	\$4,940 95	\$359 00	Melted for other purposes.
Do.	Do.	2	17	34	43	do	do	do	14,150	9,575 99		Still on the vessel.
California	Do.	2	17	32	43	do	do	do	14,000	1,972 51	192 63	Sold with the vessel.
Albatross	Do.	2	17	32	43	do	do	do	14,000	3,965 43		Do.
Congress	Do.	2	17	32	43	do	do	do	14,000	3,965 43		Still on the vessel.
Worcester	Griffiths	2	16	7 1/2	43	do	do	do	22,000	2,723 73		In store at Norfolk.
Do.	Hirsch	2	17	32	43	Boston	Boston	do	12,190	3,136 68	236 30	Removed at Norfolk and the original four-bladed screw replaced.
Do.	Do.	2	17	28	42	Washington	New York	do	14,400	4,116 28		Sold with the machinery.
Tennessee	Do.	2	19	32	42	New York	do	do	23,870	6,610 74	350 00	In store at Norfolk and the original four-bladed screw used.
Guerrero	Do.	2	17	30	42	Washington	do	do	13,774	3,965 46	290 00	In store at Mare Island. Removed from the vessel without being used and the original screw used.
Pennsola	Do.	2	18	35	42	Mare Island	Mare Island	do	14,500	4,567 44	503 57	Still on the vessel.
Ticonderoga	Do.	2	15	30	37	Boston	Boston	do	9,940	2,779 25	199 18	Removed from the vessel.
Do.	Do.	2	15	18 6	37	do	Not used	do	9,356	2,283 44	127 75	Never completed.
Lackawanna	Mangin	4	15	20	37	do	Not finished	Not cast		619 00	604 75	In store at Mare Island.
Do.	Do.	2	15	20	37	Mare Island	Mare Island	Composition	12,951	5,136 94	690 37	Refitting four-bladed screw.
Omahee	Do.	2	15	20	37	do	do	do	12,951	5,136 94		Removed from the vessel at Norfolk and a four-bladed screw substituted.
Canandaigua	Do.	2	15	20	37	New York	New York	do	9,800	3,145 60	273 00	Still on the vessel.
Do.	Do.	2	15	20	37	Norfolk	Not used	do	10,110	2,716 45		Do.
Shenandoah	Do.	2	15	20	37	Boston	Boston	do	8,891	3,086 66	110 00	Never used.
Monongahela	Do.	2	15	20	37	do	Not used	do	9,234	2,930 21		Do.
Swatara	Do.	2	12	23	25	New York	New York	do	3,968	1,230 04	171 00	Sold with the vessel.
Resaca	Do.	2	12	23	25	Mare Island	Mare Island	do	3,565	1,247 75		In store at Kittery.
Nantasket	Do.	2	12	23	25	Boston	Boston	do	3,997	1,403 81	396 23	Still on the vessel.
Quinnebaug	Do.	2	12	17	32	Washington	Not used	do	6,300	969 86	77 60	Cast from old metal.
Wyoming	Do.	2	12	19	32	do	Boston	do	6,610	1,916 98	604 26	Still on the vessel.
Wachusett	Do.	2	12	19	32	Norfolk	Norfolk	do	6,500	954 94	453 10	Cast from old metal.
Tuscarora	Do.	2	12	16	32	Washington	Kittery	do	2,900	835 23		Sold.
Nipalee	Do.	2	11	16	23	do	Washington	do	3,368	1,142 71	107 14	Still on the vessel.
Saco	Do.	2	11	16	23	do	Norfolk	do	3,983	1,191 40	190 00	Do.
Yankee	Do.	2	11	16	23	New York	New York	do	3,597	1,603 21		Do.
Admiral Porter	Do.	2	11	20	27	Washington	Washington	do	3,120	890 29		In store at Norfolk.
Do.	Do.	2	11	18	22	do	Not used	do	3,597	1,603 21		Do.
Do.	Do.	2	11	19	30	do	do	do	5,760	1,988 09		Do.
Shawmut	Griffiths	2	11	16	23	New York	do	do				

TABLE 2.—Showing the relative efficiency of the four-bladed and two-bladed screw-propellers.

Names of vessels.	The original four-bladed screws.					The two-bladed screws.					Waste of coal.		Remarks.
	Total number of nautical miles steamed by the vessel, with the four-bladed screws, as recorded by the log-books of the vessels.	Total number of pounds of coal consumed to make that distance.	Mean speed of the vessel, in nautical miles, per hour.	Slip of the screw, in per cent. of its speed.	Time during which the four-bladed screw was used.	Total number of nautical miles steamed by the vessel, with the two-bladed screws, as recorded in the log-books of the vessels.	Total number of pounds of coal consumed to make that distance.	Mean speed of the vessel, in nautical miles, per hour.	Slip of the screw, in per cent. of its speed.	Time during which the two-bladed screw was used.	Total number of pounds of coal consumed as the cube of the speed.	Total number of pounds of coal wasted by the use of the two-bladed screw.	
Swatara.....	51035	878287.7	5.259	19.55	From Nov., 1865, to July, 1869.....	10265.5	3473378.4	3.24	38.49	From Nov., 1869, to Dec., 1871..	717376	1753002	The original vessel.
Resaca.....	21945.96	4661129.6	7.44	25.428	From Sept., 1866, to Sept., 1869.....	5511.25	1306800.3	3.895	37.52	From Sept., 1869, to Nov., 1872..	694573	419497	For performance with four-bladed screw the result of the Swatara and Resaca are taken.
Nantasket.....					Four-bladed screw not used.....	12875.36	2761484.4	3.994	47.34	From Oct., 1869, to July, 1872..	1184840	1579644	The original vessel.
Nipile.....	16935.54	3397028.5	9.955	12.29	From Sept., 1863, to July, 1869.....	15949.60	3636487.5	3.113	38.49	From July, 1869, to Dec., 1872..	2198453	1628034	The original vessel.
Saco.....	17869.83	2617449.6	3.10	13.68	From Sept., 1866, to Dec., 1868.....	14266.19	3632464.5	5.046	33.05	From July, 1870, to Sept., 1876..	1672969	988495	For performance with four-bladed screw the result of the Swatara and Resaca are taken.
Yanbo.....	19763.95	3701247.6	1.80	13.23	From Aug., 1864, to Nov., 1869.....	36307.80	7059804.5	4.64	22.95	From Feb., 1870, to Mar., 1876..	5322973	1736831	The original vessel.
Kanaw.....	26340.47	4061935.7	0.73	10.37	From Sept., 1864, to Sept., 1869.....	26815.93	4697321.5	5.367	41.80	From Sept., 1870, to Mar., 1875..	9281667	8215654	Performance with the new engine.
Lactawanna.....	23596.27	6793006.6	2.93	12.72	From Jan., 1863, to Dec., 1868, & from Dec., 1873, to June 30, 1876.	19474.14	4197280.6	5.75	15.03	From June, 1872, to Sept., 1874..	6469163	9291802	
Ticonderoga.....	5892.26	1025565.7	7.149	4.296	From May, 1863, to May, 1869.....	5928.22	1633468.5	5.53	29.25	From Feb., 1871, to Oct., 1874..	3553444	2903829	
Canandaigua.....	16684.50	1410294.6	6.00	9.47	From Nov., 1863, to Feb., 1869, & from Aug., 1869, to Apr., 1865.	20213.00	6267277.5	5.104	27.91	From Feb., 1872, to May, 1875..	4112700	8506220	
Algonquian.....	26532.75	1257706.6	6.172	6.90	From June, 1865, to May, 1869, & from Nov., 1869, to Dec., 1870, & from Sept., 1870, to June 30, 1876.	17577.21	4086447.5	5.954	30.00	From Aug., 1870, to Apr., 1874..	9787612	3536454	

	California					Four-bladed screw not used	4346.75	19400206.66330.86	From April, 1871, to June, 1873.	1448810	491210	For performance of four-bladed screw the results of the Guerriere and Delaware are taken.
Guerriere	19682.08	7967170.8	004	18.56		From May, 1867, to July, 1869	7706.87	42461076.53028.36	From Aug., 1870, to Mar., 1872.	9079210	9173802	
Albany	9769.11	3273162.7	530	3.622		From Mar., 1868, to July, 1869	2380.70	10825677.82316.01	From Oct., 1869, to Jan., 1870	1203519	116892	
Congress						Four-bladed screw not used	36017.38	157114376.611331.63	From Mar., 1870, to July, 1876	12281400	3490037	
Seyern						Four-bladed screw not used	5409.00	97157855.88142.54	From Nov., 1869, to Dec., 1871	1256110	1459675	For performance of the screw with four-bladed screws the results of the Albany and Worcester are taken.
Worcester	11037.96	3947832.6	551	9.36		From Sept., 1873, to Jan., 1876	10444.25	44939175.95035.90	From Jan., 1871, to Sept., 1873	2447744	2046173	The performance of the two-bladed screw includes the Mangin screw.
Tennessee	2317.54	1977838.8	615	4.41		From June, 1866, to Jan., 1867	3788.25	17470106.19915.94	From Jan. 5, 1871, to Apr. 18, 1871	1673946	73064	The performance of the two-bladed screw includes the (two-bladed) Hirsch screw.
Wyoming	54636.35	0931481.6	813	28.45		From Oct., 1859, to Mar., 1868	15391.95	43511445.39735.61	From Nov., 1871, to Apr., 1874	1932504	2418644	Performance with the original engine.
Wachusett	30272.40	6970716.6	302	14.78		From May, 1862, to Feb., 1868	15289.15	43006225.55621.66	From June, 1871, to Dec., 1874	2725673	1574949	
Tusearora	67203.78	1426324.6	776	18.20		From Dec., 1861, to Dec., 1868	38837.67	67663594.79432.40	From June, 1872, to July, 1876	2851544	3914815	
							10,923 × $\frac{33979795}{2240}$ = \$109,536.22, the cost of the wasted coal.				33979795	

## PERFORMANCE OF THE NEW SLOOPS OF WAR.

The machinery of the eight new sloops of war authorized by the act of Congress approved February 10, 1873, are completed; several of the vessels are already in commission. As the Department was anxious to have the best machinery in them that could be obtained, advertisements were published inviting designs, and offering premiums for the best that should be offered. A number of engineering firms and constructing engineers submitted designs, as also did this bureau. They were referred to a board of experts, composed partly of naval and partly of civilian engineers. The report of that board was published in my report for the year 1873. It stated that none of the designs submitted were superior to those of the bureau, which, with some slight modifications, were recommended for adoption. It also recommended the payment of a premium of \$500 for the best rejected design. Before work was commenced on any of the vessels their plans and designs were fully completed, and approved by the proper authority, in conformity with the law authorizing their construction. These plans involved and required the arrangement and design of the hulls, armament, sail-power, storage, and berthing capacities, and indicated horses-power required to be developed by the engines in overcoming the resistance of the hulls at the required speeds, all of which were duly considered and decided upon, as set forth in the plans and specifications of their design, and were decided upon by the several chiefs of the appropriate bureaus, on their own responsibility, upon whom the responsibility of the results will rest. These vessels, and those which have been recently rebuilt on new and altered models, were not designed purely for speed, but were intended to subserve the general purposes of cruising war-vessels of moderate size. They were to have greater beam in proportion to their length than the vessels built during the few previous years. This was to allow room to work their batteries, and to carry comparatively heavy ones, and to stand up well under their canvas. Though the draught was to be light, the machinery and boilers were to be all below the water-line, and were to be capable of driving the vessels at a rate of speed fully equal to that of the average foreign vessels of the same class. All these desiderata have been obtained, and it is believed that fighting, steaming, and sailing qualities are combined in these ships at least as successfully as in any others ever built. As the performance of these vessels has been looked for with much interest both by naval officers and others interested in naval affairs and the science of marine engineering, I introduce here a table comparing the dimensions and performance of these ships with the most successful vessels of equal size in the Navy, the machinery of which was designed either by private firms or by this bureau, before and during the late war.

Names of the vessels.

	Iroquois.	Wyoming.	Adams.	Ticonderoga.	Shenandoah.	Vandalla.	Swatara.
Length on the load-line, in feet.....	198.92	198.50	185.	224.33	225.	216.	216.
Breadth, on load-line, in feet.....	33.83	33.17	35.	38.30	38.33	38.	37.
Load-draught of water in feet.....	13.17	13.	14.25	15.	15.	17.25	16.42
Displacement, in tons, at load water-line.....	1488.	1457.	1340.	2926.	2030.	2110.	1914.
Area of greatest immersed transverse section, in square feet.....	380.	366.	360.	463.	475.	516.6	450.
Ratio of breadth to length.....	5.68	5.98	5.28	6.13	5.87	5.54	5.84
Length in the vessel occupied by machinery, in feet.....	54.	52.5	53.	51.	54.	70.50	67.50
Height of boilers above load water-line, in feet.....	2.83	5.83					
Height of load water-line above the boilers, in feet.....			0.5	1.	1.	3.5	2.83
Total area of grate-surface in the boilers, in square feet.....	270.75	239.	192.	273.	273.	240.	240.
Indicated horse-power developed by the engines.....	813.	717.	930.	1304.1	1304.1	1174.	877.25
Revolutions of the engines per minute.....	77.	73.5	68.	70.	70.	60.	54.34
Speed per hour, in nautical miles.....	11.7	11.2	11.5	12.	12.	12.06	*11.39
Ratio of area of transverse section to area of grate-surfaces.....	.611	.653	.533	.589	.573	.464	.533
Indicated horse-power per square foot of grate surface.....	3.	3.	4.89	4.80	4.80	4.90	4.87
When the machinery was built.....	1859	1859	1873	1862	1862	1862-1873	1862-1873
By whom the machinery was designed.....	Pease & Murphy.	Merrick & Son.	Bureau Steam-Eng.	Bureau Steam-Eng.	Bureau Steam-Eng.	Bureau Steam-Eng.	Bureau Steam-Eng.
Capacity of the coal-bunkers, in tons.....	166.	165.	140.	332.	365.5	180.85	165.
Number of tons of coal the vessels will consume per day at maximum speed.....	30.46	28.	19.3	49.6	49.6	28.30	20.15
Number of days the vessel can steam on that quantity of coal and at maximum speed.....	5.45	6.68	7.25	6.69	7.33	6.39	8.18
Distance, in nautical miles, the vessels can make at maximum speed.....	1530.36	1795.58	2006.30	1927.	2111.04	1849.	2355.
Distance the vessels can make, at 8½ knots per hour, with the coal contained in their bunkers.....	3016.	3210.	3592.	4000.	4404.	3860.	4900.

\* Trial on four-fifths boiler-power; full-speed trial never made.

For comparison with the vessels having engines recently designed I have selected the Wyoming and Iroquois, they being favorite vessels, and regarded as having a good speed. They were built in 1859 and were duplicated after the late war commenced, and their sister ships, the Tuscarora and Oneida, proved themselves to be equally successful. The Ticonderoga and Shenandoah, built in 1862, were intended to have the same speed as the Wyoming and Iroquois, but were to carry a much greater quantity of coal. The machinery in these four vessels occupies about equal space in the hulls, though the space occupied in the latter two is less in comparison with the size of the vessels than in the former. All these vessels were intended to be fair steaming and sailing ships. In a word, they were all built with the same view. Now, assuming them to be equally well designed for this purpose, their resistance will be represented by the area of their greatest immersed midship-sections, and, as they were all designed to burn the same kind of coal, (anthracite,) the area of their grates may be taken to represent the boiler-power. Their efficiency as steamers should be measured by the cubes of the speeds, divided by the boiler-power per square foot of midship-section. The boiler-powers will then compare as follows, viz :

Wyoming .....	1.00
Iroquois .....	1.215
Adams .....	1.287
Ticonderoga .....	1.337
Shenandoah .....	1.401
Vandalia .....	1.755

The economy of the new engines is quite as apparent as the above compared efficiency of the boilers. The relative economy of the engines may be measured by the weight of coal consumed in a given time to produce a horse-power.

Name of vessel.	Number of pounds of coal per horse-power per hour.
Wyoming .....	3.64
Shenandoah .....	3.35
Ticonderoga .....	3.35
Iroquois .....	3.50
Swatara .....	2.6
Adams .....	1.93
Vandalia .....	2.25

And in their economy they will compare as follows :

Wyoming .....	0.523
Shenandoah .....	0.540
Ticonderoga .....	0.540
Iroquois .....	0.545
Vandalia .....	0.553
Swatara .....	0.945
Adams .....	1.000

So it is evident that the best of the engines recently designed is 45 per cent. more economical than the best of its predecessors. It is useless here to multiply these examples, though a large number could be given.

#### SAFETY OF OUR VESSELS.

While the foreign mails have brought us, during the past year, news of many disastrous accidents to the machinery or boilers of vessels belonging to the navy of one of the great European powers, some of which have been accompanied by great loss of life and the complete disabling of the vessels for months, it is gratifying to me to be able to report that no serious accident has happened to the machinery or boilers of any of our navy.

vessels since my last report, and that more than five years have passed since a life has been lost from such a cause. The machinery of most of our vessels has been designed by this bureau, and, while having a due regard to compactness and the smallness of the space to be occupied, the bureau has still made the moving parts of the engines strong enough to do the work expected of them in service without subjecting the materials of which they are constructed to undue or dangerous strains. The boilers, too, have been built with special regard to their safe and economical operation, and all the means which ingenuity could devise or experience suggest have been used to render them in every respect safe and reliable. While under construction, whether at navy-yards or elsewhere, the work is carefully superintended by engineer officers, who are specially detailed for that duty, and from the time their construction is commenced to the time when the machinery is finally worn out and removed, it is always in the charge of engineer officers who are held to strict responsibility for its proper management and careful preservation.

#### PERSONNEL OF THE ENGINEER CORPS.

Many vacancies still exist in the list of assistant engineers, but these, it is hoped, will be eventually filled by the graduates of the engineering branch of the Naval Academy, and by the appointment of such candidates from civil life as may prove themselves to be thoroughly qualified. These latter, however, are not likely to be numerous, as the standard of qualification is a high one, and cannot well be lowered in view of the important and responsible nature of the duties to be performed. Of those who apply, it is found that a considerable proportion fail to pass the rigorous physical examination which is very properly required to precede the professional one. Of those who pass physically, about one-half are found deficient professionally. The successful ones are usually those who have been engaged for a time in the actual building of steam-machinery, and have also studied at some one or other of the technological institutions which are to be found at or near the principal centers of our manufacturing districts.

During the past year, at the request of the director-general of the Centennial Exhibition, leave of absence was granted to a chief engineer in the Navy, who was placed at the head of the bureau of machinery of the exhibition and in charge of Machinery Hall. Most of his assistants on this duty were ex-members of the Naval Engineer Corps; and I may here remark that the services of many ex-members of this corps have been found valuable and highly appreciated by State and municipal governments in the prosecution of public improvements, as well as by schools of engineering, as instructors, and by private corporations and employers in the management of manufacturing and engineering works.

#### NAVAL ACADEMY.

During the summer vacation the steam-building had a small extension built to it, and now affords sufficient facilities for the practical instruction of the cadet engineers in the construction of steam-machinery. The summer cruise of the practice-steamer *Mayflower* was an eminently satisfactory one. She visited the principal northern and eastern ports and navy-yards, where the cadets, with their instructors, had ample opportunity of seeing all the leading ship and engine building establishments, both public and private. Proprietors of private establishments showed their interest in the cause of scientific education by gladly

throwing open their works to the inspection of the cadets. They have also presented to the academy models of various machines, which were required by the institution, to be used for purposes of instruction.

#### ENGINEER'S FORCE ON SHIPBOARD.

Since my last report no complaints have been received of the inefficiency or insufficiency of the engineer's force on shipboard. The restoration of the ratings of first and second class fireman to the engineer's force, and their being considered a permanent part of that force, has had a good effect upon the discipline and zeal of these men, has made them more contented, and the best of them will be more likely to re-enlist and become "continuous-service" men than has heretofore been the case. The dullness of trade, by throwing many excellent mechanics out of employment, has induced a better class of men to enter the service as machinists. In order to retain their services permanently, and to secure proper discipline in the engine-room, where they are often necessarily left in immediate charge, I would respectfully recommend that a greater distinction should be made between them and the firemen than now exists, especially in the matter of granting them more frequent liberty on shore, when they can be spared from duty, and that they should be allowed a chest or locker in place of a bag in which to keep their clothes.

#### EXPERIMENTS.

Appended, and marked "A," is a report of some experiments made on the combustion, both in the lump and in a finely-pulverized state, of semi-bituminous coal from the mines of Cumberland, Md. Marked "B" is a report of the experiments made to determine the relative merits of a common screw and that patented by Mr. N. H. Patterson, of Tennessee.

Very respectfully,

WM. W. W. WOOD,  
Chief of Bureau.

HON. GEO. M. ROBESON,  
Secretary of the Navy.

#### A.

*Experiments made with a horizontal fire-tube boiler in East Boston, Mass., to ascertain the economic vaporization given by semi-bituminous coal from the mines of Cumberland, Md., burned on the grate wholly in the state of lumps, with air supplied by a fan-blower delivering both below and above the grate; and burned partly in the lump state on the grate and partly in a very finely pulverized state, uniformly disseminated throughout the furnace above the grate, the air being supplied by another fan-blower delivering both below and above the grate, and carrying with it in the latter case the pulverized fuel which is thus blown into the furnace.*

The experiments recorded in this paper were made on the process of Messrs. Whelpley & Storer for effecting the complete and rapid combustion of coal-dust in the furnaces of steam-generating boilers. The system of these gentlemen consists in maintaining a bed of ignited lump-coal on the grate-bars of the furnace in the usual manner, and then, by means of a blast of atmospheric air, in blowing into the furnace above this bed of ignited lump-coal, finely pulverized coal—pulverized, indeed, to an impalpable powder. There is thus delivered into the furnace, above the ignited lump-coal, an intimately-mixed mass of air and coal-dust, the latter obtaining the oxygen for its combustion from the former. The lump-coal obtains the oxygen for its combustion from the air ascending through the spaces between the grate-bars in the usual manner.



Without the bed of ignited lump-coal beneath, the combustion of the coal-dust above it could not be maintained, and it is considered equally necessary by the patentees that an arch of fire-brick should be interposed between the consuming masses and the metal of the boiler directly over the grate-bars, in order to retain the highest possible temperature in the gases in the furnace for the purpose of still more effectually securing the combustion of the coal-dust. The brick arch is intended to intercept and radiate back the heat radiated to it from the ignited lump-coal on the grate-bars. Of course, the atmospheric air will be heated to only an inappreciable degree by either the original radiation or its reflex, but the coal-dust will be.

With the exception of this brick arch, the boiler may be of any design. The lump-coal is first reduced by a patented apparatus (which is the only portion of Messrs. Whelpley & Storer's process that is patented or patentable) to the state of impalpable powder, and it is then fed, together with air, through a conduit to the central portion of an ordinary centrifugal or fan blower, whose revolutions draw it in and drive it through another conduit which discharges it into the front of the furnace through an air-tight aperture. The lump-coal is fired in the usual manner, through the furnace-door, and the air for its combustion is supplied by another fan-blower delivering into a closed ash-pit beneath the grate-bars. The whole combustion is therefore effected by artificial draught depending on mechanism; and the force of this draught is easily regulated from the least to the greatest desirable in burning coal; it can also be distributed at will, so as to preserve within certain limits any required proportion between the weights of lump and dust coal consumed in the same time. The two fan-blowers, in the experiments about to be described, were operated by the same steam-engine which effected the coal-crushing and worked the feed-pump of the boiler.

The patentees imagine that, compared with the combustion of lump-coal, a more nearly perfect combustion was to be obtained with impalpably fine coal-dust mixed thoroughly with and suspended in air, thereby presenting to the latter, for a given weight of coal, an immensely greater surface than in the lump-state. They imagined, too, that, from the same cause, a much higher rate of combustion would be obtained than probable with lump-coal, by which means a boiler with a much smaller grate-surface, but with the same heating surface, would furnish with the coal-dust the same quantity of steam in equal time, and with greater economy of evaporation per pound of fuel than with the lump-coal. It was to determine the truth or error of these assumptions that the following experiments were made. They were intended to have been very extensive, embracing anthracite and coke as well as bituminous and semi-bituminous coals; and also a species of exceedingly hard anthracite found in Rhode Island, which contains about 40 per centum of incombustible mineral matter, and is worthless from its difficulty of ignition and slowness of combustion for burning in lumps. The results from different rates of combustion and of different proportions of dust to lump coal consumed in equal time, was likewise to have been ascertained, but the experiments were prematurely closed, as the Government could not longer dispense with the services of the naval engineers making them. The entire expense of the experiments, other than the pay of the engineers, was borne by the patentees.

The following is a description of the boiler and of the coal and air-feeding apparatus.

#### BOILER.

The boiler is composed of a horizontal cylindrical shell 40 inches in external diameter and 10 feet in extreme length. The flat ends of this shell are the tube-plates, and in them are secured seventy-four wrought-iron tubes of 2.05 inches inside and 2½ inches outside diameter; extreme length of tubes, 10 feet. The tubes are horizontal; they are surrounded by the water, and the gases of combustion pass through them. They are arranged in vertical rows, one over the other.

The shell is set in brick masonry, and the furnace, which is composed of brick masonry, is placed beneath its front end. From this furnace the gases of combustion pass along 6 feet 6 inches of the shell, embracing its semi-circumference for that length, then ascend a back smoke-connection of 12 inches length and 40 inches width formed in the masonry, then return horizontally through the tubes, and emerge into the uptake, formed also in the masonry for its height, and on the top of which the smoke-pipe is placed. An iron door in the lower part of the uptake, opposite the tubes, allows them to be swept. The uptake is 15 inches long and 40 inches wide.

The front of the furnace and ash-pit is in the same vertical plane with the front of the uptake. The ash-pit is 20 inches wide in the clear, and 4 feet 5 inches long; its sides are formed of brick masonry, and its back is a brick wall 10½ inches thick. Its front is closed by a cast-iron door shutting air-tight.

From the bottom of the ash-pit to the top of the grate-bars is 20 inches. A horizontal cast-iron dead-plate 15 inches wide extends from the furnace-front to the grate-bars, which are horizontal and on the same level with the plate. They are 3 feet 2 inches long, and occupy a width of 20 inches, making the grate-surface 5.277 square feet. On each side of this surface and of the dead-plate is brick masonry, the top of

which, starting from the top of the grate-bars, inclines outward, so that at a height of 6 inches it touches the side of the furnace at its greatest width of 40 inches. From this point a brick arch  $2\frac{1}{2}$  inches thick, the under side of which has a radius of 7 inches, extends over the entire grate-surface and dead-plate. The back of the furnace or bridge-wall is formed by a vertical extension of the back of the ash-pit; its top is an inverted curve of 52 inches radius until it intercepts the arch above it. The front of the furnace is of cast iron, and is fitted with the usual door.

The air-conduit or blast-pipe which delivers air for combustion in the closed ash-pit is 5 inches in diameter. It lies beneath the fire-room floor, and discharges the air vertically upward beneath the grate-bars.

The coal-dust conduit which delivers the pulverized fuel and the air for its combustion into the front of the furnace, is 5 inches in diameter, diminishing at its point of discharge to 2 inches diameter. It lies above the fire-room floor, and discharges into the furnace horizontally.

The shell of the boiler is of  $\frac{1}{2}$  inch thick iron, the ends of  $\frac{3}{8}$  inch thick iron, and the tubes are of  $\frac{1}{16}$  inch thick iron.

The following are the principal proportions of the boiler when experimenting with pulverized coal, columns C and D of the following table, the brick arch being present over the grate-bars:

Heating-surface in the bottom of the boiler-shell.....	34.033 square feet.
Heating-surface in the two ends of the boiler-shell.....	11.351 square feet.
Heating-surface in the 74 tubes, calculated for their inner diameter of 2.05 inches.....	397.133 square feet.
<b>Total heating-surface.....</b>	<b>442.517 square feet.</b>
Length of grate-bars.....	3 feet 2 inches.
Breadth occupied by grate-bars.....	1 foot 8 inches.
Area of grate-surface.....	5.277 square feet.
Area for the passage of the gases of combustion over the bridge-wall of the furnace.....	0.764 square feet.
Area through tubes for the passage of the gases of combustion..	1.696 square feet.
Area of the smoke-pipe for the passage of the gases of combustion.	1.867 square feet.
Capacity of steam-room above 3 inches above top of tubes.....	13.5 cubic feet.
Ratio of the heating to the grate surface.....	83.538 to 1.000
Ratio of the grate-surface to the area over the bridge-wall.....	6.907 to 1.000
Ratio of the grate-surface to the area through the tubes.....	3.112 to 1.000
Ratio of the grate-surface to the area of the smoke pipe.....	2.827 to 1.000
Diameter of the smoke-pipe, (inner).....	1 foot 6 $\frac{1}{2}$ inches.
Height of the smoke-pipe above the level of the grate-bars.....	40 feet.
Distance traversed by the gases of combustion from the center of the furnace to their delivery into the uptake.....	20 feet.

The only change made when experimenting with lump-coal, columns A and B in the following table, was the removal of the portion of the brick arch which lay immediately beneath the shell of the boiler, except the small portion necessary to support the shell and the brick partition separating the uptake from the chamber behind the bridge-wall. This removal increased the heating-surface in the bottom of the boiler shell, and changed its proportion, but left everything else as before. The heating-surface in experiments A and B was as follows:

Heating-surface in the bottom of the boiler-shell.....	48.431 square feet.
Heating-surface in the two ends of the boiler-shell.....	11.351 square feet.
Heating-surface in the seventy-four tubes, calculated for their inner diameter of 2.05 inches.....	397.133 square feet.
<b>Total heating-surface.....</b>	<b>456.915 square feet.</b>
Ratio of the heating to the grate surface, 86.586 to 1.000.	

#### MANNER OF MAKING THE EXPERIMENTS.

The experiments were conducted by a board composed of Chief Engineers Macomber, Kellogg, and Johnson, United States Navy, assisted by four assistant engineers, who stood regular watches of four hours, as at sea, and personally weighed, measured, and counted all the quantities recorded. The process with each experiment was the same, and as follows:

Steam was first raised with wood to the pressure of 40 pounds per square inch above the atmosphere; and then the water in the boiler being adjusted to 3 inches above the top of the tubes, the coal was fired, the number on the counter and the time were noted, the small engine started, and the experiment held to commence.

Each experiment lasted exactly 48 consecutive hours, at the expiration of which, the water-level and steam-pressure being the same as at the commencement, the fire was promptly hauled from the furnace and wetted out, and the unconsumed coal picked out, weighed, and deducted from the amount expended.

All the ashes and refuse, including the sweepings of the tubes, and the accumulations behind the bridge-wall and in the uptake, were weighed on the same scales and in the same tub with the coal.

Every pound of coal consumed was carefully weighed. It was the first quality of semi-bituminous from the Cumberland mines of Maryland; and a separate account was kept of the quantities consumed in the lump and in the pulverized state during each hour of the experiment.

All the water pumped into the boiler was previously carefully measured in a cylindrical iron tank provided with an overflow-pipe, to which it was each time filled, and then pumped out entirely dry by the boiler-feed pump. The tank was filled by a lifting-pump, which required from seven to eight minutes to fill it, according to the speed at which the small engine ran.

The water-level in the boiler was shown by a glass gauge.

The bed of lump-coal on the grate-bars was kept 5 inches thick, well cleaned and free of holes. The boiler-tubes were cleaned or "blown out" once in every four hours, by opening the uptake-door and inserting successively in each tube a short piece of  $\frac{3}{4}$ -inch diameter gas-pipe, connected by means of gum steam-hose to the steam-pipe. The average time required for thus cleaning all the tubes was 5 minutes.

At the end of each hour there was entered into the columns of the tabular record kept by the board the number of pounds of lump and of pulverized coal thrown into the furnace; the height of the barometer; the temperatures of the external atmosphere of the engine-room, of the fire-room, of the water in the tank, of the same water after passing through the heater and before it entered the boiler, and of the products of combustion in the boiler-uptake and in the top of the chimney. In other columns there was entered the state of the weather except during experiment C. At the end of each experiment all the ash and sweepings were weighed.

The temperatures were taken by ordinary mercurial thermometers graduated to Fahrenheit's scale. The temperature of the atmosphere was given by one hung outside the building, in the shade. The one giving the temperature of the engine-room hung 9 feet from the engine, and the one giving the temperature of the fire-room hung 3 feet 6 inches from the boiler-front. The feed-water temperatures, both in the tank and after passing the heater, were given by thermometers kept constantly immersed.

The temperature of the gases of combustion in the boiler-uptake was obtained from a thermometer suspended in it through a hole in a top-plate, the thermometer being opposite the center of the boiler end and 9 inches from it. The temperature of these gases in the top of the chimney was given by a thermometer suspended in it 14 inches below the top and 38 feet 10 inches vertically above the grate-bars.

The small engine was non-condensing, and exhausted into a very large heater, through which the feed-water passed on its way from the tank to the boiler, receiving therein a considerable increase of temperature. The cylinder was 10 inches in diameter with a 20-inch stroke of piston. The diameter of the piston-rod was  $1\frac{1}{4}$  inches, giving a net area of piston of 77.9265 square inches. This engine operated a length of 62 feet of shafting, exclusive of a counter-shaft of 33 feet length. It worked the lifting-pump supplying the tank, the feed-pump supplying the boiler, the two fan-blowers, and the pulverizing apparatus. The length of belting used was 179 feet. At the end of each hour an indicator diagram was taken from each end of the cylinder, and on it was recorded the number of double strokes of piston made per minute at the time. The cylinder-pressures given in the table are the means of all the diagrams taken. A large number of diagrams was also taken with the unloaded engine; that is, with the pumps not pumping, with the air prevented from entering the fan-blowers, and with the pulverizing apparatus free of coal, but with the shafting running, in order to ascertain the net pressure required to do the work *per se*, the work consisting of the pumping, the fan-blowing, and the pulverizing.

The number on the engine-counter was noted in the tabular record at the commencement of each experiment, and at the end of each hour, and in an adjacent column was entered the number of double strokes made per minute by the engine's piston, so as to avoid possibility of error.

The safety-valve of the boiler was weighted by an accurate gauge to "blow off" at 40 pounds steam-pressure per square inch above the atmosphere. All the steam used by the small engine was taken from the boiler, and the remainder was discharged through the safety-valve into the air.

#### EXPLANATION OF THE TABLE.

The experiments were four in number, two with lump-coal burned alone, and two with lump-coal burned on the grates and with pulverized coal burned disseminated in

air in the furnace above the lump-coal. The data and results of these experiments will be found respectively in columns A, B, C, and D of the table. In experiments A and B, the brick arch which was present over the whole grate-surface in experiments C and D was partly removed, thereby increasing the area of heating-surface, which in experiments A and B with lump-coal alone was 456.915 square feet; and in experiments C and D with lump and pulverized coal, 442.517 square feet. As the patentees considered the brick arch a necessity in their system, its disadvantage in diminishing the area of the heating-surface should be allowed to operate against that system in a comparison with any other. For this reason the arch was removed when experimenting with lump-coal alone. It must be observed here, however, that the enormous quantity of heating-surface in proportion to grate-surface, which the patentees had given their boiler, prevented the reduction of heating-surface by the presence of the arch from being nearly as disadvantageous as it would have been with the boiler-proportions of ordinary practice. In experiments A and B the heating-surface was 56.54 to 1,000 of grate-surface, while in experiments C and D it was 83.538 to 1,000. The usual proportion being about 25 to 1, and the quantity of surface affected by the brick arch being constant, it will be readily perceived that the effect of the arch will be considerable with the latter proportion, while it was probably insensible with the former. Under the actual conditions, then, of the experimental boiler, the experiments made with lump and pulverized coal gave higher results, comparatively to those made with lump-coal alone, than would have been the case had the boiler been constructed of the usual proportions of heating to grate surface.

For facility of reference, the lines containing the quantities are numbered, and the quantities arranged in groups.

For the same purpose, each column containing the data and results of an experiment is lettered.

Line 1 gives the date of commencing each experiment. The columns, it will be observed, are in the order of the dates of the experiments.

Line 2 gives the state of the weather for all the experiments except C.

#### TOTAL QUANTITIES.

Line 3 contains the duration of each experiment in consecutive hours.

Line 4 contains the total number of pounds of water pumped from the tank into the boiler. It was previously carefully measured in the tank, allowance being made for the temperatures on line 20.

Line 5 contains the total number of pounds of coal consumed on the grate-bars in the lump state. Every pound was carefully weighed on a Fairbanks platform-scale, tested before commencing the experiments.

Line 6 contains the total number of pounds of the same coal consumed in the pulverized state, and fed into the furnace disseminated in air. Every pound was weighed on the same scales as the lump-coal.

Line 7 contains the sum of the quantities on lines 5 and 6, and gives the total aggregate weight of coal consumed in both states.

Line 8 contains the total number of pounds of refuse in ash, clinker, and soot from the weight of coal on line 7.

Line 9 contains the total aggregate weight of combustible matter in the coal in both states. It is the quantities on line 7 less those on line 8.

Line 10 shows the per centum which the quantities on line 9 are of those on line 7.

Line 11 shows the per centum which the quantities on line 5 are of those on line 7.

Line 12 shows the per centum which the quantities on line 6 are of those on line 7.

Line 13 contains the total number of double strokes made by the piston of the engine, as taken by a self-registering counter.

#### COMBUSTION.

Line 14 contains the number of pounds of coal consumed per hour. It is the quotient of the division of the quantities on line 6 by those on line 3.

Line 15 contains the number of pounds of the combustible portion of the coal consumed per hour. It is the quotient of the division of the quantities on line 9 by those on line 3.

Lines 16 and 17 contain, respectively, the number of pounds of coal and of its combustible portion consumed per hour per square foot of grate-surface. They are the quotients of the division of the quantities on lines 14 and 15 by 5.277, the number of square feet in the grate-surface.

Line 18 contains the fraction of a pound of combustible consumed per hour per square foot of heating-surface. It is the quotient of the division of the quantities on line 15 by 456.915 for experiments A and B, and by 442.517 for experiments C and D, these numbers being the square feet of heating-surface employed in the respective experiments.

## TEMPERATURES.

Lines 19, 20, and 21 contain, respectively, in degrees Fahrenheit the average temperature of the external atmosphere of the engine-room and of the fire-room.

Line 22 contains the average temperature in degrees Fahrenheit of the boiler feed-water when it was measured in the tank. And line 23 contains the average temperature of the same water after it had been through the heater interposed between the tank and boiler. The increase of temperature received by the feed-water in the heater was due to the abstraction of heat from the exhaust-steam of the small engine, which discharged through the heater into the air.

Lines 24 and 25 contain the average temperature in degrees Fahrenheit of the gases of combustion. The first gives it in the uptake, the last at the top of the chimney.

Line 26 shows the average height of the barometer in inches of mercury.

## ENGINE.

Line 27 shows the average number of double strokes of engine's piston made per minute. It is the quotient of the division of the quantities on line 11 by 2,880, the number of minutes the experiments continued.

Line 28 contains the average steam-pressure in the boiler, in pounds, per square inch above the atmosphere, as given by an Ashcroft spring-gauge. It was kept exactly the same in all the experiments.

Line 29 shows the proportion of the throttle-valve, which was open during the experiments. It remained unchanged during each experiment.

Line 30 contains the mean gross effective steam-pressure on the piston of the small engine in pounds per square inch. It is the mean of ninety-six indicator-diagrams for each experiment; a diagram being taken at the end of each hour from each end of the cylinder.

Line 31 contains the pressure on the piston in pounds per square inch, required to work the machinery *per se*; that is to say, to work the engine and shafting, with the water shut off from the pumps, the air shut off from the fan-blowers, and no coal in the pulverizer. It is the mean of a large number of indicator-diagrams taken at the beginning and end of each experiment under these conditions.

Line 32 contains the net pressure upon the engine-piston in pounds per square inch. It is the remainder of the quantities on line 30 after subtracting those on line 31.

Lines 33 and 34 contain the gross effective and net horse-power developed by the small engine. These powers are calculated respectively for the piston-pressures on lines 30 and 32.

## VAPORIZATION.

Lines 35 and 36 contain the total number of pounds of water that would have been vaporized in the boiler had the water been supplied at respectively the temperatures of 100 and 212 degrees Fahrenheit, instead of the temperature on line 23; and had the vaporization been effected under a pressure of 14.687 pounds per square inch above zero, instead of under the pressure on line 28.

Lines 37 and 38 contain the number of pounds of water vaporized from the temperature of 100 degrees Fahrenheit, and under the atmospheric pressure of 14.687 pounds per square inch by one pound of coal, and by one pound of the combustible portion of that coal, respectively.

Lines 39 and 40 contain the number of pounds of water vaporized from the temperature of 212 degrees Fahrenheit, and under the atmospheric pressure of 14.687 pounds per square inch by one pound of coal, and by one pound of the combustible portion of that coal, respectively.

Table exhibiting the data and results of the experiments made with a horizontal fire-tube boiler in East Boston, Mass., to ascertain the comparative economic vaporization given by semi-bituminous coal from the Cumberland mines of Maryland, burned on the grate wholly in the state of lumps, with air supplied by a fan-blower delivering both below and above the grate; and burned partly in the lump state on the grate and partly in a very finely pulverized state uniformly disseminated throughout the furnace above the grate, the air being supplied by another fan-blower delivering both below and above the grate, and carrying with it, in the latter case, the pulverized fuel, which is thus blown into the furnace.

Number of line.		Burning lump coal alone.— Brick arch removed from over part of grate-surface. Air for combustion supplied below and above grate-surface by a fan-blower.		Burning lump coal on the grate and pulverized coal in the furnace above the lump coal.—Brick arch in place over grate-surface. Air for combustion of the lump coal supplied below the grate-surface by a fan-blower. Air for combustion of the pulverized coal supplied above the lump coal by the same fan-blower, being mixed with the pulverized fuel which blows into the furnace.	
		Medium rate of combustion.	Maximum rate of combustion.		
		A.	B.	C.	D.
1	Date of commencing the experiment.....	1 p. m., Dec. 9, 1867.	Mer., Dec. 17, 1867.	Mer., Nov. 14, 1867.	Mer., Dec. 2, 1867.
2	State of the weather .....	Clear 40 hrs., snowing 8 hrs. Light breeze.	Clear 36 hrs., cloudy 12 hrs. Bet. a light and gentle breeze.		Clear 33 hours, cloudy 13 hrs. of which 5 hrs. snowed 5 hrs. Bet. slight and gentle breeze.
	<b>TOTAL QUANTITIES.</b>				
3	Duration of the experiment in consecutive hours.....	48.	48.	48.	48.
4	Pounds of water pumped into the boiler from the tank.....	27,094.	53,268.	26,606.	29,456.
5	Pounds of semi-bituminous coal consumed in the state of lumps.....	3,168.	5,775.	1,791.	1,382.
6	Pounds of semi-bituminous coal consumed in the pulverized state.....			1,377.	1,776.
7	Aggregate number of pounds of semi-bituminous coal consumed.....	3,168.	5,775.	3,168.	3,168.
8	Pounds of refuse in ash, clinker, and soot, from the aggregate number of pounds of semi-bituminous coal consumed.....	353.	490.	282.	304.
9	Aggregate number of pounds of combustible consumed.....	2,815.	5,285.	2,886.	2,864.
10	Per centum of the coal in refuse of ash, clinker, and soot.....	11.15	8.48	8.90	9.5
11	Per centum of the total coal consumed in the lump state.....	100.00	100.00	56.30	43.94
12	Per centum of the total coal consumed in the pulverized state.....			43.50	56.06
13	Number of double strokes made by the engine's piston.....	231,777.	231,459.	228,534.	230,216.
	<b>COMBUSTION.</b>				
14	Pounds of coal consumed per hour.....	66.000	120.312	66.000	66.000
15	Pounds of combustible consumed per hour.....	58.646	110.104	60.125	59.47
16	Pounds of coal consumed per hour per square foot of grate-surface.....	12.507	22.615	12.507	12.507
17	Pounds of combustible consumed per hour per square foot of grate-surface.....	11.113	20.865	11.394	11.27
18	Pounds of combustible consumed per hour per square foot of heating-surface.....	0.128	0.241	0.136	0.12
	<b>TEMPERATURES.</b>				
19	Temperature, in degrees Fahrenheit, of the external atmosphere.....	12.6	20.7	34.5	31.2
20	Temperature, in degrees Fahrenheit, of the engine-room.....	36.5	56.6	43.8	53.2
21	Temperature, in degrees Fahrenheit, of the fire-room.....	45.3	60.	55.3	66.4
22	Temperature, in degrees Fahrenheit, of the water in the tank.....	37.	44.	47.1	42
23	Temperature, in degrees Fahrenheit, of the feed-water after passing through the heater.....	185.	182.	193.	180
24	Temperature, in degrees Fahrenheit, of the gases of combustion in the boiler uptake.....	383.3	485.1	391.7	372

Table exhibiting the comparative economic vaporization of semi-bituminous coal, &amp;c.—Cont'd.

Number of blue.		Burning lump coal alone.— Brick arch removed from over part of grate-surface. Air for combustion sup- plied below and above grate-surface by a fan- blower.		Burning lump coal on the grates and pulverized coal in the furnace above the lump coal.—Brick arch in place over grate-surface. Air for combustion of the lump coal supplied below the grate-sur- face by a fan-blower. Air for combustion of the pulver- ized coal supplied above the lump coal by the same fan- blower, being mixed with the pulverized fuel which it blows into the furnace.	
		Medium rate of combustion.	Maximum rate of combustion.	C.	D.
		A.	B.		
23	Temperature, in degrees Fahrenheit, of the gases of combustion in the top of the chimney .....	206.8	207.6	215.0	207.3
26	Barometer, in inches of mercury .....	29.86	29.89	29.69	29.75
ENGINE.					
27	Number of double strokes of engine's piston made per minute .....	80.478	80.368	79.352	80.144
28	Steam-pressure in boiler, in pounds, per square inch, above the atmosphere .....	40.	40.	40.	40.
29	Proportion of throttle-valve open .....	0.052	0.055	0.063	0.063
30	Mean gross effective pressure on piston, in pounds, per square inch .....	5.09	5.25	6.50	6.50
31	Pressure on piston, in pounds, per square inch, required to work the unloaded ma- chinery .....	4.30	4.30	4.30	4.30
32	Net pressure on piston, in pounds, per square inch .....	0.79	0.95	2.20	2.20
33	Gross effective horse-power developed by the engine .....	3.225	3.321	4.060	4.101
34	Net horse-power developed by the engine .....	0.500	0.600	1.374	1.388
VAPORIZATION.					
35	Pounds of water that would have been va- porized, had it been supplied at the tem- perature of 100 degrees Fahrenheit, and vaporized under a pressure of 14.687 pounds, per square inch, above zero .....	25,516.848	53,300.967	24,857.091	27,602.820
36	Pounds of water that would have been va- porized, had it been supplied at the tem- perature of 212 degrees Fahrenheit, and vaporized under a pressure of 14.687 pounds, per square inch, above zero .....	28,498.256	59,528.692	27,761.412	30,828.021
37	Pounds of water vaporized from 100 degrees Fahrenheit by one pound of coal .....	8.055	9.230	7.846	8.713
38	Pounds of water vaporized from 100 degrees Fahrenheit by one pound of combustible .....	9.065	10.065	8.613	9.638
39	Pounds of water vaporized from 212 degrees Fahrenheit by one pound of coal .....	8.996	10.308	8.763	9.731
40	Pounds of water vaporized from 212 degrees Fahrenheit by one pound of combustible .....	10.124	11.264	9.619	10.864

## REMARKS.

In examining the results of experiments A and B, in which lump-coal was burned alone, we find that, notwithstanding nearly twice as much coal was burned per hour in experiment B as in experiment A, yet the economic vaporization was greater in the former than in the latter by  $\left( \text{line 40, } \frac{11.255 - 10.120 \times 100}{10.120} \right) 11.21$  per centum of the latter

This arises, probably, in part from the enormous ratio of the heating to the grate surface, namely, 86.586 to 1,000, which was sufficient to cool down the gases of combustion in the uptake with the greater rate of combustion to within 101.8° Fahrenheit of the temperature (line 24) with the lesser rate of combustion; but principally from the less air in proportion to coal consumed furnished in experiment B than in experiment A. It will be observed that in both experiments the fan-blowers were driven at the same speed, and of course threw into the furnace the same quantity of air in equal time; hence the proportion of air supplied to the combustible matter in experiment B must have been to that supplied in experiment A inversely as

the weights of this matter consumed in equal times, or as 2315 to 5255, line 9. The effect of the too great quantity of air in experiment A was to carry off a large portion of heat in raising its temperature from that of the fire-room (line 21) to that of the gases of combustion in the boiler-uptake, (line 24,) so that, notwithstanding the gases of combustion in the boiler-uptake were at 101.8° Fahrenheit less temperature in experiment A than in experiment B, yet the economic vaporization was 11.21 per centum worse. The lower temperature in the uptake only indicates a higher economic vaporization on the supposition that the proportion of air to combustible matter is the same.

In examining the results of experiments C and D, in which lump-coal was burned on the grate-bars and pulverized coal in the furnace above them, we find that, although the aggregate weight of combustible matter burned per hour was almost exactly the same in both, yet the economic vaporization was greater in the latter than in the former by

(line 40,  $\frac{10.761 - 9.617 \times 100}{9.617} =$ ) 11.89 per centum of the former. In these two experi-

ments it will be observed that the ratio of lump to pulverized coal is reversed. In experiment C the pulverized coal is 43.50 per centum of the aggregate consumed, leaving 56.50 per centum to be burned in the lump state; while in experiment D the pulverized coal is 56.06 per centum of the aggregate consumed, leaving the lump-coal 43.94 per centum of that aggregate. The results of the experiments, however, do not warrant attributing the higher economic vaporization in experiment D to the higher proportion which the pulverized bears to the lump-coal in that experiment over what it does in experiment C. Experiment C was the first made, and experiment D was the same, repeated, but burning a higher proportion of pulverized coal. And it was repeated with very great care in the firing. In both experiments, C and D, about the same proportion of air to combustible matter consumed was supplied, and as the temperature of the gases of combustion in the boiler-uptake only differed 19.7 degrees Fahrenheit, the difference in the economic vaporization must be attributed to difference in the firing.

A very correct comparison can be made of the relative economic efficiency of semi-bituminous coal burned wholly in the lump state and partly in the lump and partly in the pulverized state, by means of the economic vaporization in experiment A, during which the coal was consumed in the lump state alone, and the mean economic vaporization in experiments C and D, during which the coal was consumed partly in the lump and partly in the pulverized state; because in these three experiments the rate of combustion and the supply of air were almost exactly the same; in fact, all the conditions were sensibly the same.

Now, in experiment A, 11.113 pounds of lump-coal were consumed per hour per square foot of grate-surface, with 80.478 double strokes of the piston of the engine supplying air, the resulting vaporization per pound of the combustible portion of the coal being 10.124 pounds of water from the temperature of 212 degrees Fahrenheit and under the atmospheric pressure.

The mean rate of combustion in experiments C and D was  $\left(\frac{11.394 + 11.307}{2} =\right)$

11.350 pounds of the combustible portion of the coal consumed per hour per square foot of grate-surface, with  $\left(\frac{79.352 + 80.144}{2} =\right)$  79.748 double strokes per minute of

the piston of the engine supplying air, the resulting vaporization per pound of the combustible portion of the coal being  $\left(\frac{9.619 + 10.764}{2} =\right)$  10.192 pounds of water from

the temperature of 212 degrees Fahrenheit and under the atmospheric pressure.

The two economic results—namely, 10.124 and 10.192—are almost identical, and show that when semi-bituminous coal is burned at the same rate of combustion, with the same *pro rata* air-admission, and under the same circumstances, it gives the same economic vaporization, whether it be consumed wholly in the lump state, or partly in the lump and partly in the pulverized state, or wholly in the pulverized state. This equality of economic result is also proven by the fact of the equality of the temperature of the gases of combustion in the comparable experiments when leaving the boiler. In experiment A, burning lump-coal alone, this temperature was 333.30 degrees Fahrenheit, while the mean of the temperatures of the gases of combustion in the boiler-uptake during experiments C and D, during which partly lump-coal and partly pulverized coal were consumed, was  $\left(\frac{391.7 + 372.0}{2} =\right)$  381.85 degrees Fahrenheit.

This comparison is made, however, for the heating effects alone of the coal in the two states, burned under the same circumstances, and is exclusive of the cost in fuel of pulverizing the coal and of blowing the dust into the furnace. A correct commercial comparison must include this cost, which is only incurred when the coal is used in the pulverized state, because when it is used in the lump state it can be burned as rapidly with the natural draught as the pulverized coal can be with the artificial



draught obtained by the fan-blowers. The reason why the pulverized coal cannot be consumed at a greater rate with the fan-blowers than the lump-coal can be consumed with the average draught given by the boiler-chimney is, that the former requires a certain time for ignition and combustion, which is much longer than the latter requires, because the temperature to which the former is exposed above the bed of incandescent fuel on the grate-bars is much less than the temperature of that bed to which the latter is exposed.

The cost of the net horse-power in average practice may be taken at about 4 pounds of coal per hour. Now, the mean of experiments C and D gave  $\left(\frac{1.374 + 1.388}{2} =\right)$  1.381 net horse-power developed by the engine in pulverizing the coal and in blowing the dust into the furnace, and in pumping the feed-water into the tank, which, at 4 pounds of coal per hour per horse-power, is 5,524 pounds of coal per hour, or, as the coal consumed per hour was 66 pounds,  $\left(\frac{5,524 \times 100}{66} =\right)$  8.37 per centum of the total weight of coal burned. Consequently, the pulverized coal was commercially 8.37 per centum inferior to the lump-coal.

In experiment A, during which lump-coal was burned alone, there was required to drive the fan-blowers and to pump the feed-water 0.500 net horse-power, which, at 4 pounds of coal per hour per horse-power, required 2,000 pounds of coal per hour to produce it, and, as the hourly consumption of coal during that experiment was 66 pounds, there were consumed in producing the artificial draught and in pumping the feed-water  $\left(\frac{2,000 \times 100}{66} =\right)$  3.06 per centum of the total weight of coal burned.

Deducting this 3.06 per centum from the 8.37 per centum found in the immediately preceding paragraph, there remains 5.31 per centum of the total weight of coal consumed applied to the pulverization of the coal alone.

It must be distinctly understood that the results of these experiments are only for semi-bituminous coal, and that no inferences drawn from them are warranted as regards other kinds of coal. The experiments were unfortunately terminated before trials of other kinds of coal could be made, but they were afterward resumed with another boiler, and extended to include anthracite as well as semi-bituminous coal. The results of these later experiments have been given in a preceding paper.

The total weight of semi-bituminous coal consumed during these experiments was 15,279 pounds, of which 1,429 pounds, or 9.35 per centum, was refuse of ash, clinker, and soot.

As the pound of the combustible portion of the semi-bituminous coal vaporized under the same conditions the same weight of water whether the coal was burned in the lump state alone, or partly in the lump and partly in the pulverized state, the mean results of the four experiments may be taken to give the performance of the boiler with semi-bituminous coal. These means are as follows:

Number of pounds of coal consumed per hour.....	79.578
Number of pounds of combustible consumed per hour.....	72.135
Number of pounds of coal consumed per hour per square foot of grate-surface.....	15.080
Number of pounds of combustible consumed per hour per square foot of grate-surface.....	13.670
Number of pounds of coal consumed per hour per square foot of heating-surface.....	0.177
Number of pounds of combustible consumed per hour per square foot of heating-surface.....	0.160
Per centum of the coal in refuse of ash, clinker, and soot.....	9.35
Temperature, in degrees Fahrenheit, of the gases of combustion in the boiler-uptake.....	408.
Pounds of water vaporized under the atmospheric pressure and from the temperature of 100 degrees Fahrenheit by 1 pound of coal.....	8.592
Pounds of water vaporized under the atmospheric pressure and from the temperature of 100 degrees Fahrenheit by 1 pound of combustible.....	9.478
Pounds of water vaporized under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit by 1 pound of coal.....	9.596
Pounds of water vaporized under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit by 1 pound of combustible.....	10.586
Ratio of the water-heating (mean) to the grate-surface.....	85.222 to 1.000
Ratio of the grate-surface to the cross-area through the tubes, for draught.....	3.112 to 1.000
Very respectfully, your obedient servant,	

B. F. ISHERWOOD,  
Chief Engineer, U. S. N.

SEPTEMBER 10, 1875.

To Engineer-in-Chief WM. W. W. WOOD,

U. S. Navy, Chief of the Bureau of Steam-Engineering, Navy Department.

## B.

NEW YORK NAVY-YARD, *December 14, 1874.*

SIR: In accordance with your order of the 4th ultimo, we have made a careful experimental examination of the propeller applied by Mr. N. A. Patterson, of Tennessee, to the tug-boat Rocket, attached to the New York navy-yard, with the view of ascertaining its propelling efficiency relatively to that of the regular screw with which the Rocket was originally fitted.

As we are required by your order to set forth the economy of Mr. Patterson's propeller relatively to that of the regular screw, the ratios of their slips with equal power expended, and our opinion whether or not Mr. Patterson's propeller should be adopted for screw-propulsion in preference to the screws heretofore used, together with our reasons therefor, we have the honor to state that our results, experimental and inferential, will be found embodied in the following

## REPORT.

Before detailing the experiments with the competitive regular and Patterson screw propellers, it is proper to give a description of the vessel and machinery with which they were made, in order that it may be understood whether the experimental conditions, as regard magnitude and appropriateness, were such that their results can be accepted for general application.

## HULL.

The tug-boat Rocket, with which the competitive experiments with the regular screw and with the Patterson screw were made, has an exceedingly sharp yacht-model, with great dead-rise at the amidship cross-section. The keel is very much deeper at the stern-post than at the stem, having been carried down to give the screw as much diameter as practicable. The hull is of wood, coppered, and without spars, and has the following dimensions:

Extreme length over all .....	98 feet.
Length on the water-line, from the forward edge of the rabbet of the stem to the after-side of the stern-post .....	84 feet 8 inches
Extreme breadth on the water-line .....	18 feet 9 inches
Draught of water from the bottom of the keel:	
Forward .....	5 feet 3 inches
Mean .....	7 feet 3 inches
Aft .....	9 feet 3 inches
Depth of keel amidship, below the lower edge of the rabbet .....	8 inches
Greatest immersed transverse section .....	104.3 square feet.
Displacement .....	155.6 tons
Ratio of the greatest immersed transverse section to its circumscribing parallelogram .....	0.845 to 1.00
Ratio of the displacement to its circumscribing parallelopipedon .....	0.520 to 1.00
Ratio of the length to the breadth, on the water-line .....	4.516 to 1.00

## ENGINE.

There is one non-condensing vertical direct-acting engine, with the axis of its cylinder perpendicular above the axis of the screw-shaft. The cylinder, has but one valve, which is a three-ported slide equilibrated on the back by Adams's arrangement, and worked by the Stephenson link, with two eccentrics. This valve cuts off the steam at 0.841 of the stroke of the piston from the commencement, by lap on the steam side, and commences to cushion, or compress the steam in the cylinder, by exhaust-lap when the piston is at 0.15 of its stroke from the end. The feed-pump and bilge-pump are worked from the main cross-head, which moves between vertical guides. The sides of the cylinder are felted and lagged, but its ends and the valve-chest are uncovered. The steam-pipe is felted. The cylinder is placed above the spar-deck, in an engine-house of light joinery, well ventilated. Fresh feed-water is used, carried in a tank, and, before being pumped into the boiler, has its temperature raised by the exhaust-steam, in a heater. The following are the principal dimensions of the engine:

Number of cylinders .....	1
Diameter of the cylinder .....	25½ inches.
Diameter of the piston-rod .....	3½ inches.
Stroke of the piston .....	24½ inches.
Net area of the piston, after deducting area of piston-rod .....	491.323 square inches
Space-displacement of the piston, per stroke .....	7.0727 cubic feet.
Space in clearance and steam-passage at one end of the cylinder .....	0.3273 cubic foot.
Area of the steam-port .....	31.5 square inches.
Diameter of crank-pin journal .....	5½ inches.
Length of crank-pin journal .....	6 inches.

## BOILER.

There is one boiler forward of the engine, and it is of the lower-flue and upper-rem-n horizontal tube type, with large steam-drums, and considerable superheating surface. The shell and its drums are thoroughly covered with felt, and the draught is forced by exhausting the steam into the chimney.

The front portion of the shell contains the furnaces, uptake, and nearly half the length of the tubes; it is rectangular in plan and semi-cylindrical on top; 7 feet 3½ inches wide, 7 feet 9½ inches long, and 8 feet 3 inches high. The back portion of the shell is a flat-ended cylinder 7 feet 3½ inches in diameter, and 7 feet ½ inch in length; its top is a horizontal extension of the semi-cylindrical part of the front portion. The total length of the boiler is 14 feet 10 inches.

There are two furnaces with vertical sides and elliptical crowns. Each furnace is 3 feet wide and 7 feet long in the clear, of which length the grates occupy 5 feet 9 inches, the remainder being occupied by a cast-iron bridge-wall, with ends perforated by small holes for the admission and distribution of air to the hot gases of the fuel. The crown of the furnace at the front is 3 feet 4 inches above the level of the grate, and at the back 3 feet 7 inches. The opening for the furnace-door is 16 inches square, and the floor is perforated with small holes for the admission and distribution of air to the hot gases of the fuel. The flat water-spaces at the front and back of the furnaces are 4½ inches wide, including thicknesses of metal; and the flat water-space between the furnaces is 6 inches wide, including thicknesses of metal. The ash-pit is a cast-iron pan placed beneath the front portion of the shell and kept filled with water.

From each furnace there extend to the back smoke-connection three lower horizontal flues of 5 feet 2 inches length. One is 9 inches in internal diameter, one 15 inches, and one 20 inches. The least water-space between the flues is 3 inches.

The back smoke-connection is in common for both furnaces. Its top is flat, and its bottom and sides are concentric with the circular shell, and 3½ inches distant, including thicknesses of metal. The length of the connection, lengthwise the boiler, is 22½ inches in the clear. The thickness of the flat water-space between the back of the connection and the end of the shell is 4½ inches, including thicknesses of metal. A circular manhole of 16 inches diameter in the end of the shell, gives admission to the connection for cleaning and repairs.

From the back smoke-connection to the uptake there extend three rows of horizontal iron tubes. The two lower rows contain 13 tubes each, and the upper row 11 tubes, making 37 tubes in all. The extreme length of all the tubes is 10 feet. Those of the lower row are 4½ inches outside diameter; those of the upper row are 4 inches outside diameter; and of those of the center row four are 4 inches diameter and nine are 4½ inches outside diameter. All the tubes are expanded in their plates.

The uptake is rectangular in form, having a flat top and bottom, while the sides are concentric with the circular shell. It is 30½ inches long in the clear, lengthwise the boiler, 18 inches high, and is in common for all the tubes. Its entire front is occupied by a hinged door, for sweeping the tubes.

The chimney rises vertically from the center of the top of the uptake. It is 26 inches in internal diameter, and 27 feet in height above the level of the grates.

Above the top of the shell and surrounding the chimney is a cylindrical steam-superheater, 3 feet in outside height and 3 feet 9 inches in outside diameter. The distance from the top of the shell to the bottom of the superheater is 1 foot.

Upon the top of the shell and at the center of its length is a cylindrical steam-drum of 4 feet outside diameter and 4 feet height above the top of the shell.

The following are the principal dimensions and proportions of the boiler:

Extreme length of the boiler.....	14 feet 10 inches.
Extreme breadth of the boiler.....	7 feet 3½ inches.
Extreme height of the boiler, exclusive of steam-drum and ash-pan.....	8 feet 3 inches.
Extreme height of the boiler, inclusive of steam-drum and ash-pan.....	13 feet.
Number of furnaces.....	2
Width of furnace.....	3 feet.
Length of grate-surface.....	5 feet 9 inches.
Aggregate area of grate-surface.....	34.5 square feet.
Number of lower flues.....	6
Length of lower flues.....	5 feet 2 inches.
Number of tubes.....	37
Length of tubes.....	10 feet.
Outside diameter of tubes.....	4 and 4½ inches.
Diameter of chimney.....	2 feet 2 inches.
Height of chimney above level of grates.....	27 feet.
Steam-room in boiler-shell.....	85.5 cubic feet.

Steam-room in superheater.....	19.0 cubic feet.
Steam-room in steam-drum.....	50.5 cubic feet.
Total steam-room.....	155.0 cubic feet.
Cross-area of the lower flues.....	7.701 square feet.
Cross-area of the tubes.....	2.333 square feet.
Cross-area of the chimney.....	4.700 square feet.
Heating-surface in the furnaces.....	164.000 square feet.
Heating-surface in the lower flues.....	119.000 square feet.
Heating-surface in the back smoke-connection.....	63.000 square feet.
Heating-surface in the tubes.....	280.772 square feet.
Heating-surface in the uptake.....	46.228 square feet.
Aggregate water-heating surface.....	673.000 square feet.
Steam-superheating surface in the boiler-shell and in the super-heater.....	28.000 square feet.
Ratio of the water-heating to the grate surface.....	19.507 to 1.000.
Ratio of the steam-superheating to the grate surface.....	0.811 to 1.000.
Ratio of the grate-surface to the cross-area of the flues.....	4.480 to 1.000.
Ratio of the grate-surface to the cross-area of the tubes.....	14.788 to 1.000.
Ratio of the grate-surface to the cross-area of the chimney.....	7.340 to 1.000.

## REGULAR SCREW.

The regular screw is of cast iron, and has a uniform pitch. The edges of its blades, when viewed in projection on a plane parallel with the axis, are parallel to each other, and are at right angles to the axis. The thickness of the blade just above the fillet joining it to the hub is 4 inches.

Diameter of the screw.....	7 feet 3 inches.
Diameter of the hub.....	1 foot 3 inches.
Number of blades.....	4.
Pitch of the screw.....	14 feet.
Length of the screw in the direction of the axis.....	2 feet.
Fraction used of the pitch.....	$\frac{1}{4}$
Helicoidal area of the screw.....	32.332 square feet.
Projected area of the screw on a plane at right angles to the axis...	22.890 square feet.

## PATTERSON SCREW.

The screw, which for distinction will be designated the Patterson screw, is of cast iron, and has the same diameter, and the same diameter of hub, as the competitive regular screw above described; but its generatrix, instead of being a straight line, as in the case of that screw, is straight for only  $2\frac{1}{4}$  feet of its total length of  $3\frac{1}{2}$  feet, (the radius of the screw,) the remaining length of  $1\frac{1}{4}$  foot, or 31 per centum, having so rapid a curvature that the outer end of the generatrix, that is, the end at the periphery of the screw, rises 7 inches above the straight part, which gives a concave surface to the outer  $1\frac{1}{4}$  foot, measured radially, of the propelling surface of the blade. The forward edge of the blade is perpendicular to the axis, and the propelling-surface of the blade for a length of 24 inches, measured in the direction of the axis, has a uniform pitch of 14 feet. From this point the pitch expands gradually, but very rapidly, to the after edge of the blade, a distance of 8 inches, measured in the direction of the axis; the mean pitch of this 8-inches-long part being 24 feet, makes the mean pitch of the entire screw in function of surface  $16\frac{1}{2}$  feet. The propelling-surface at the after outer angle of the blade being formed by the mitering of the curved part of the generatrix and the curved part of the directrix, has a dishing or spoon form. The after edge of the blade for  $1\frac{1}{2}$  foot from the periphery of the screw is parallel with the forward edge, and is perpendicular to the axis; from this point it tapers forward and joins the hub at the same point as the regular screw.

From this description it will be seen that the Patterson screw is exactly the same as the regular competitive screw for two-thirds of its length, with 31 per centum of its generatrix from the outer extremity curved up 7 inches, and having the remaining one-third of its length made with a rapidly-increasing pitch, the mitering of the two curves at the outer after angle of the blade giving the propelling-surface there a spoon-like concave form.

The thickness of the blade just above the fillet joining it to the hub is 4 inches. The weight of the screw is 3,338 pounds.

The following are the principal dimensions:

Diameter of the screw.....	7 feet 3 inches.
Diameter of the hub.....	1 foot 3 inches.
Number of blades.....	4.
Mean pitch of the screw.....	16 feet 6 inches.
Length of the screw in the direction of the axis on the hub.....	2 feet.

Length of the screw in the direction of the axis at the radius of 22½ inches .....	2 feet 8 inches.
Length of the screw in the direction of the axis at the periphery.....	2 feet 8 inches.
Fraction used of the mean pitch in function of surface.....	$\frac{1}{4}$ ths.
Helicoidal area of the screw.....	39.654 sq. feet.
Projected area of the screw on a plane at right angles to the axis....	26.931 sq. feet.

## MANNER OF MAKING THE COMPETITIVE TRIALS.

During the competitive trials made with the two screws above described, the vessel was kept at the same draught of water, was run over the same bases the same number of times, and the same method of observation was employed.

Two bases were used, one on the right and the other on the left bank of the Hudson River, both being perfectly straight and a few miles above New York City. The first had its lower extremity at Pleasant Valley Dock, about half a mile below Fort Lee, and its upper extremity at Englewood Dock; its length, carefully measured on the large Coast-Survey chart, is 17,914 feet. The last had its lower extremity at the lock on the northern bank of the Spuyten Duyvil Creek, and its upper extremity at the large dock of the southern suburb of the city of Yonkers; its length, carefully measured on the large Coast-Survey chart, is 18,850 feet. Six runs were made over each base, three in one direction and three in the other, making in the aggregate twelve runs, six in each direction.

During these runs the steam-pressure in the boiler and the position of the throttle-valve were kept uniform, and the vessel's course a straight line. The indicator-diagrams were taken as rapidly as possible by an expert assistant, so as to make them nearly continuous, and they averaged one per minute. The gross effective indicated pressure given in the following table, containing the results of the competitive trials, is the mean of all the diagrams taken in the respective cases. The time was accurately noted by two observers when the vessel passed the ranging-marks at each end of the base, while a third observer took the number on the counter. After passing the ranges the vessel was kept under the same conditions during her turnings, and sufficient space was taken to bring her up to the first marks at her regular speed. The trials at the first base were made in August, 1874, and at the last base in the November following.

At the first base there was first made the trial of the regular screw, that being already attached to the vessel. The bottom of the latter was somewhat foul, as she had not been locked for some time, and this operated, in the comparison, against the regular screw, as when the vessel was docked to put on the Patterson screw the bottom was cleaned. But at the last base there was first made the trial of the Patterson screw, the bottom of the vessel being somewhat foul by the intervening three months' exposure. After that trial the vessel was docked to put on the regular screw, and the bottom was cleaned at the same time. By taking the mean, therefore, of the trials at both bases, the effect of the fouling of the vessel's bottom is equalized for both screws.

The vessel's speed, uninfluenced by wind or current, was obtained as follows: The speed in geographical miles of 6,086 feet per hour was calculated by the time and distance for each single run without regard to the tide; then the mean of the means of every consecutive two runs was accepted for the true speed during the trial in water still and smooth. In the comparison of the economic results from the two screws the cube of this speed is taken as the measure of the effect produced by the net power developed by the engine in the respective cases.

The net power is taken as the measure of the cost of the effect produced, and not the gross effective power; the net power being the remainder of the gross effective indicated power after deduction of the power required to work the engine, *per se*, and the propriety of employing it for the purpose of the comparison becomes evident when the fact is considered that the friction or resistance to motion of the engine, *per se*, must be overcome before any power can be applied to the screw. The net power is identical with the dynamometrical power, and was calculated for each run, the mean being taken for the true net horse-power developed by the engine when the vessel was propelled at the speed as above determined.

The force and direction of the wind and the state of the water was the same in both competitive trials, and their results may be briefly summarized by stating that the regular screw had a slip of 16.64 per centum and an economic propelling efficiency represented by

represented by  $\left( \frac{8.8404^3}{104.4692} = \right) 4.472743$ , while the Patterson screw had a slip of 24.69 per

centum and an economic propelling efficiency represented by  $\left( \frac{8.6430^3}{160.1009} = \right) 4.032736$ ; and, as the numbers 4.472743 and 4.032736 compare as 1.0000 to 0.9017, the Patterson screw was 10½ per centum less efficient than the regular screw.

*Table containing the results of the competitive trials in the Hudson River of the United States tug-boat Rocket with the regular screw-propeller and with the propeller furnished by Mr. N. A. Patterson.*

	Regular screw, 14 feet pitch.	Patterson screw, 16½ feet mean pitch.
Vessel's draught of water, in feet and inches { forward ..... 5 3 mean ..... 7 3 aft ..... 9 3		
Kind of breeze .....	Gentle	Gentle
Direction of breeze .....	Abeam	Abeam
State of the water .....	Smooth	Smooth
Mean gross effective pressure on piston, in pounds per square inch .....	34.57	36.35
Mean net pressure on the piston, in pounds per square inch .....	32.57	36.35
Mean number of double strokes of piston made per minute .....	76.8350	71.355
Gross effective horses-power developed by the engine .....	163.9545	162.989
Net horses-power developed by the engine .....	154.4692	160.1009
Speed of the vessel per hour in geographical miles of 6,086 feet .....	8.8404	8.4241
Slip of the screw in per centum of its speed .....	16.64	24.12
Relative economic efficiency of the screws .....	1.0000	0.8077

#### DISTRIBUTION OF THE POWER.

The distribution of the power with the two screws during the preceding competitive trials has been calculated by allowing, first, for the pressure required to work the engine, *per se*, 2 pounds per square inch of piston, and deducting the horses-power due to this pressure from the gross effective indicated horse-power developed by the engine; the remainder is the net horses-power applied to the screw-shaft. Then, from this latter power is deducted the horses-power absorbed by the friction of the load, calculated from Morin's co-efficient of  $\frac{7}{8}$  per centum; and also the horses-power expended in overcoming the cohesive resistance of the water by the screw-blades, calculated for the value of 0.45 pound per square foot of helicoidal surface moving in its helical path with the velocity of 10 feet per second. The remainder is the horses-power expended in the slip of the screw and in the propulsion of the hull, and is divided between them in the proportion of the slip to unity minus the slip.

	Regular screw.		Patterson screw.	
	Horses-power	Per cent.	Horses-power	Per cent.
Gross effective horses-power developed by the engine .....	163.9545		162.9888	
Power required to work the engine <i>per se</i> .....	9.4853		8.8088	
Net power applied to the screw-shaft .....	154.4692	100.00	160.1009	100.00
Power absorbed by the friction of the load .....	11.5852	7.50	12.0076	7.50
Power expended in overcoming the resistance of the water by the screw-blades .....	11.4000	7.38	12.0759	7.54
Power expended in the slip of the screw .....	21.8789	14.16	33.5827	20.97
Power expended in the propulsion of the vessel .....	109.6051	70.96	102.4347	63.53
Totals .....	154.4692	100.00	160.1009	100.00

#### THRUST OF THE SCREWS.

The thrust of the two screws during the competitive trials can be easily calculated from the above "distribution of the power" in the following manner, namely: The horses-power expended in the propulsion of the vessel, being converted into foot-pounds by its multiplication by 33,000, and then divided by the speed of the vessel in feet per minute, gives the thrust of the screw in pounds.

These calculations having been made, show the thrust of the regular screw to have been 4,033.59 pounds, and that of the Patterson screw 3,855.81 pounds.

*Comparative resistances of the regular screw and of the Patterson screw when going ahead and when backing, with the vessel stationary at the wharf.*

Experiments on the resistances of the screws when going ahead and when backing were made with the vessel secured to the navy-yard wharf, the influence of the tide being inappreciable.

The engine was first operated ahead until in uniform action, when twenty indicator diagrams were taken as rapidly as possible, the number of revolutions made by the screw during the time of taking the diagrams being ascertained from the counter. The engine was then reversed and the same process repeated. About sixteen minutes were occupied in each case, and the results were as follows:

#### FOR THE REGULAR SCREW.

In going ahead with the regular screw, 56.4375 revolutions were made per minute, with a gross effective indicated pressure of 43.57 pounds per square inch of piston, or a net pressure of 41.57 pounds; and in backing 61.0625 revolutions were made, with a gross effective indicated pressure of 44.54 pounds per square inch of piston, or a net pressure of 42.54 pounds. As the revolutions of the screw are as the square roots of the net pressures on the piston, if this pressure in going ahead had been the same as in backing, the revolutions in going ahead would have been 57.0922 per minute. Consequently, with equal net pressures upon the piston, the regular screw made  $\left( \frac{61.0625}{57.0922} = \right)$  6.95 per centum more revolutions when backing than when going ahead.

#### FOR THE PATTERSON SCREW.

In going ahead, with the Patterson screw, 61.7000 revolutions were made per minute, with a gross effective indicated pressure of 44.29 pounds per square inch of piston, or a net pressure of 42.29 pounds; and in backing 67.6160 revolutions were made, with a gross effective indicated pressure of 44.38 pounds per square inch of piston, or a net pressure of 42.38 pounds. The net pressures in these cases being almost exactly the same, the Patterson screw made  $\left( \frac{67.6160}{61.7000} = \right)$  9.59 per centum more revolutions when backing than when going ahead with equal net pressures.

The regular screw was, therefore, much more efficient in backing than the Patterson screw.

*Relation between the net pressures on the piston required to give the screw the same number of revolutions per minute when the vessel is held stationary to the wharf and when it is freely under way.*

The preceding data enable a determination to be made, for each screw, of the relation between the net pressures on the piston required to give the screw the same number of revolutions per minute when the vessel is held stationary to the wharf and when freely under way. And, first,

#### FOR THE REGULAR SCREW.

When the vessel was stationary at the wharf, the regular screw made in going ahead 56.4375 revolutions per minute with a net pressure on the piston of 41.57 pounds per square inch, and when steaming freely, having the same immersion, it made 76.8350 revolutions per minute, with the net pressure of 32.57 pounds per square inch of piston. Now, as the net pressures are, *ceteris paribus*, as the squares of the number of revolutions made in a given time by the screw, this pressure for 56.4375 revolutions per minute would be  $(76.8350^2 : 32.57^2 :: 56.4375^2 : )$  17.57 pounds per square inch of piston. Hence it appears that, revolution for revolution, there were required when the vessel was stationary at the wharf  $\left( \frac{41.57}{17.57} = \right)$  136.60 per centum more pressure to turn the regular screw than when the vessel was freely under way.

Again, as the number of revolutions made by the screw per minute is, *ceteris paribus*, as the square roots of the net pressures on the piston, the 76.8350 revolutions made with the net pressure of 32.57 pounds per square inch when the vessel was freely under way, would become, with the net pressure of 41.57 pounds per square inch  $\sqrt{32.57 : 76.8350} :: \sqrt{41.57} :$  86.8041 revolutions per minute; and, as this net pressure of 41.57 pounds gave the screw 56.4375 revolutions per minute when the vessel was stationary at the wharf, it follows that with equal net pressures on the piston the regular screw will make  $\left( \frac{86.8041}{56.4375} = \right)$  53.81 per centum more revolutions in the same time when the vessel is steaming freely than when it is held stationary at the wharf.

#### FOR THE PATTERSON SCREW.

When the vessel was stationary at the wharf the Patterson screw made, in going ahead, 61.7000 revolutions per minute with a net pressure on the piston of 42.29 pounds

per square inch, and when steaming freely, having the same immersion, it made 71.3550 revolutions per minute with the net pressure of 36.35 pounds per square inch of piston. Now, as the net pressures are, *ceteris paribus*, as the squares of the number of revolutions made in a given time by the screw, this pressure for 61.7000 revolutions per minute would be  $(71.3550^2 : 36.35 :: 61.7000^2 : )$  27.18 pounds per square inch of piston. Hence it appears that, revolution for revolution, there were required when the vessel was stationary at the wharf  $\left(\frac{36.35}{27.18} = \right)$  33.74 per centum more pressure to turn the Patterson screw than when the vessel was freely under way.

Again, as the number of revolutions made by the screw per minute is, *ceteris paribus*, as the square roots of the net pressures on the piston, the 71.3550 revolutions made with the net pressure of 36.35 pounds per square inch when the vessel was freely under way, would become with the net pressure of 42.29 pounds per square inch  $(\sqrt{36.35} : 71.3550 :: \sqrt{42.29} : )$  76.9646 revolutions per minute; and, as this net pressure of 42.29 pounds gave the screw 61.7000 revolutions when the vessel was stationary at the wharf, it follows that, with equal net pressures on the piston, the Patterson screw will make  $\left(\frac{76.9646}{61.7000} = \right)$  24.74 per centum more revolutions in the same time when the vessel is steaming freely than when it is held stationary at the wharf.

*Performance of the machinery of the United States tug-boat Rocket, in smooth water, with the regular screw.*

Advantage was taken of the opportunity afforded by the preceding experiments to ascertain the performance of the machinery of the Rocket with the regular screw, and burning anthracite in the furnaces.

For this purpose the vessel was run during seven consecutive hours with an unchanged throttle-valve and uniform steam-pressure in the boiler; the anthracite consumed and the refuse from it being carefully weighed. Indicator-diagrams were taken at intervals of about two minutes, and from the average of all of them the cylinder-pressures are ascertained. The speed of the vessel is computed from the number of revolutions made by the screw per minute, its pitch of 14 feet, and its slip of 16.64 per centum, as determined by its trials over the measured base.

The throttle-valve was kept considerably closed, so as to preclude any possibility of foaming or priming in the boiler. The anthracite was of average quality, and in the condition it was delivered by the contractor. The blast in the chimney was constantly used, and regulated from time to time so as to maintain the steam-pressure with almost perfect uniformity. There was no heating of journals or any other derangement of the machinery.

The revolutions made by the screw were registered by a counter. The feed-water was fresh and carried in a tank, whence it passed to a heater where its temperature was raised to 130 degrees Fahrenheit by the exhaust steam before it was pumped into the boiler.

VESSEL.		
Vessel's draught of water, in feet and inches.....	{ forward. 5 mean 7 aft. 9	
Area of the vessel's greatest immersed transverse section, in square feet.....		104.1
Displacement of the vessel, in tons.....		153.5
ENGINE.		
Number of double strokes of engine's piston made per-minute.....		74
Steam-pressure in boiler, in pounds per square inch, above the atmosphere.....		61
Throttle-valve.....	Much closed	
Fraction of the stroke of the piston completed when the steam was cut off.....		2.5
Height of the barometer, in inches of mercury.....		29.8
TEMPERATURE.		
Temperature, in degrees Fahrenheit, of the atmosphere.....		61
Temperature, in degrees Fahrenheit, of the river-water.....		62
Temperature, in degrees Fahrenheit, of the feed-water.....		130
COMBUSTIBLE.		
Pounds of anthracite consumed per hour.....		127.1
Pounds of refuse per hour from the anthracite.....		2.6
Pounds of combustible consumed per hour.....		165.1
Per centum of the anthracite in refuse.....		17
Pounds of anthracite consumed per hour per square foot of grate-surface.....		36.1
Pounds of anthracite consumed per hour per square foot of heating-surface.....		1.5
Pounds of combustible consumed per hour per square foot of grate-surface.....		36.5
Pounds of combustible consumed per hour per square foot of heating-surface.....		1.5



SPEED.	
Speed of the vessel per hour in geographical miles of 6,086 feet .....	8.514
Slip of the screw in per centum of its speed .....	16.64
STEAM-PRESSURES IN CYLINDER, PER INDICATOR.	
In pounds per square inch above zero at commencement of stroke of piston .....	64.82
In pounds per square inch above zero at point of cutting off the steam .....	51.00
In pounds per square inch above zero at end of stroke of piston .....	42.00
In pounds per square inch above zero against the piston during its stroke .....	21.75
Mean gross effective pressure on piston, in pounds, per square inch .....	32.85
Mean total pressure on piston, in pounds, per square inch .....	54.00
Mean net pressure on piston, in pounds, per square inch .....	30.25
POWER.	
Absolute :	
Gross effective horses-power developed by the engine .....	147.308
Total horses-power developed by the engine .....	246.655
Net horses-power developed by the engine .....	138.173
Economic :	
Pounds of anthracite consumed per hour per gross effective horse-power .....	8.691
Pounds of anthracite consumed per hour per total horse-power .....	5.149
Pounds of anthracite consumed per hour per net horse-power .....	9.191
Pounds of combustible consumed per hour per gross effective horse-power .....	7.155
Pounds of combustible consumed per hour per total horse-power .....	4.973
Pounds of combustible consumed per hour per net horse-power .....	7.623
CONDENSATION.	
Pounds of steam discharged per hour from the cylinder into the atmosphere, calculated from the pressure of the steam at the end of the stroke of the piston .....	6838.658
Pounds of steam condensed per hour in boiler and cylinder to furnish the heat transmuted into the total power developed by the engine .....	704.672
Sum of the above two quantities .....	7543.330

## CONCLUSIONS.

As the foregoing experiments were made for the purpose of ascertaining whether a certain propeller, supposed to be the subject of a valid patent, had sufficient superiority over the regular screw in use in the Navy to warrant its adoption in place of the latter, the necessity arises to investigate the nature of the alleged patent, and to determine whether it was valid, and if so, whether it was or was not embodied in the propeller furnished by the patentee and experimented with. For, if the patent be not valid, (and the mere granting of it by the Patent-Office is no proof of validity,) or if it be not embodied in the propeller actually experimented with, then, whatever merit the latter may possess, its use is free to all, and the Navy Department may employ it at discretion, without payment of royalty or fee.

Two patents have been issued to Mr. N. A. Patterson, of Tennessee, for improvements in screw-propellers. The first, numbered 135,149, and dated January 21, 1873, is for a conoidal blade with a circular periphery and a small, pointed test-like extension, the blade being placed at an angle with the shaft to which it is connected by a radial arm. It is simply a dish or saucer, with a small piece of the rim broken out, placed at an angle with the shaft and attached radially to the same by an arm. As the propeller furnished by the patentee and applied to the Rocket had not a single feature in common with this, any further consideration of the first patent is unnecessary.

The second patent, which is numbered 142,269, and dated August 26, 1873, is, as described therein, for a "helicoidal propeller-blade having a concave face with a curvature of equal or nearly equal radius in each direction from a point at or near the forward or cutting edge." And again, for "a concavo-convex propeller-blade, a portion of whose concave surface has a curvature of equal or nearly equal radius in an inward, outward, and rearward direction from a point at or near the forward or cutting edge." These two citations are the *claims* allowed by the Patent-Office, and constitute the entire patent. A propelling surface constructed in accordance with them would not be helicoidal, as stated in the patent, but conoidal, the apex of the conoid being the "point at or near the forward or cutting edge" of the blade. It would form a propeller whose pitch would be different at every point of the blade, both radially and in the direction of the axis, and whose generatrix would be curved with a different curvature at every point of the blade. This is the sole novel feature of Mr. Patterson's propeller, and the only one patented by him, namely, that the surface of the blade is a segment of a conoid whose apex is at or near the forward edge of the blade, making,

in fact, each blade half a conoid. The only difference from his previous patent is in the location of the apex of the conoid at the forward edge of the blade instead of at its center, and in the outline given to the blade, which is not restricted to a circle as before.

Now, the screw furnished by Mr. Patterson and applied to the Rocket was not made in accordance with either of his patents. On the contrary, he has no patent for it, or for any part of it; nor does it contain a single feature not previously well known and largely employed. It is simply a helicoid, the outer 31 per centum of the length of whose generatrix is curved, the remaining 69 per centum being straight; and the after 25 per centum of the length of whose directrix is curved, the remaining 75 per centum being straight. These features of a generatrix and a directrix curved, in whole or in part, date from the earliest adaptations of the helicoid as a submerged propeller; and they have neither superiority nor inferiority over the straight generatrix and directrix of the regular screw—that is to say, provided the diameter, number of blades, length, and mean pitch of helicoids be the same, they will give identical propelling results, whether their generatrices and directrices be straight or curved. This is a result which, though of abundant experimental demonstration, might have been easily inferred when it is understood that water is displaced vertically by the screw, and not horizontally, a misconception of which fact has been the fruitful parent of many devices for remedying a purely imaginary defect by the application of a physical property of water having no existence in nature.

Under the actual conditions of the experiments, and with the proportions possessed by the two competitive screws, the so-called Patterson screw gave, as has been shown, an economic propelling efficiency 10½ per centum less than that of the regular screw. This inferiority is due solely to its greater slip, and its greater slip is due solely to its greater mean pitch. Had the mean pitch and the length of the Patterson screw been the same as that of its competing regular screw, the economic propelling effects would have been the same. Even the regular screw might have had its economic propelling efficiency increased considerably by lessening both its pitch and its length; the diameter being limited by the dimensions of the vessel, and, therefore, not admitting of increase. The backing efficiency of the Patterson screw, relatively to its propelling efficiency, is much less than the backing efficiency of the regular screw, relatively to its propelling efficiency.

In conclusion, we reply categorically to the questions of your order of the 4th ultimo, as follows, namely:

1st. The economy of Mr. Patterson's propeller, relatively to that of the regular screw, is 10½ per centum less, the economic efficiency of the regular screw being taken for unity. In backing, the efficiency of Mr. Patterson's screw is greatly less than that of the regular screw.

2d. The slip of the regular screw is 16.64 per centum; that of Mr. Patterson's screw is 24.69 per centum.

3d. We are of opinion that Mr. Patterson's propeller should not be adopted for screw propulsion in preference to the screws heretofore used.

4th. The reasons for the above opinions, experimental and inferential, are contained in the data of the competitive trials and in the calculated results therefrom, given in extenso in the body of this report.

All of which is respectfully submitted by, sir, your obedient servants,

B. F. ISHERWOOD,  
GEO. SEWELL.  
ROBERT DANBY,

*Chief Engineers, United States Navy.*

Vice-Admiral S. C. ROWAN, U. S. N.,  
*Commanding New York Navy-Yard and Station.*

## NO. 10.—BUREAU OF CONSTRUCTION AND REPAIR.

NAVY DEPARTMENT,  
BUREAU OF CONSTRUCTION AND REPAIR,

*November 15, 1876.*

SIR: In compliance with your instructions, I have the honor to forward herewith a report of the transactions coming under the cognizance of the Bureau of Construction and Repair during the past year, together with the estimates for appropriations required for the fiscal year ending the 30th day of June, 1878.

Estimate A is for the pay of employ  s attached to this bureau, as authorized by acts of Congress.

Estimate B is for the necessary preservation of vessels on the stocks and in ordinary; purchase of materials and stores of all kinds; labor in navy-yards and on foreign stations; preservation of materials; purchase and repair of tools; wear, tear, and repair of vessels afloat, and general maintenance of the Navy; incidental expenses, advertising, and foreign postages; and for completing and making entirely ready for sea the five (5) double-turreted iron-clads, already in hand, and in process of complete repair.

The appropriation for the protection of live-oak timber, asked for in the estimates for the fiscal year ending the 30th day of June, 1877, was not made by Congress, consequently the timber-agents were discharged when the appropriation made for that purpose was exhausted. Under the impression that Congress does not deem it necessary to employ agents to look after and take care of the live-oak timber belonging to the Government, no estimate has been made for that purpose.

Repairs have been made upon the following vessels during the past year, viz:

Enterprise,	Hartford,	Hartford,
Ranger,	Intrepid,	Huron,
Adams,	Mayflower,	Juniata,
Camauche,	Minnesota,	Lehigh,
Wabash,	Phlox,	Marion,
Wachusett,	Powhatan,	Tuscarora,
Alert,	Plymouth,	Tennessee,
Colorado,	Shawmut,	Monocacy,
Amphitrite,	Supply,	Ashuelot,
Miantonomoh,	Swatara,	Saco,
Terror,	Trenton,	Omaha,
Puritan,	Vandalia,	Sea Weed,
Essex,	Antietam,	Ajax,
Monadnock,	Burlington,	Fortune,
Quinnebang,	Constitution,	Mahopac,
Constitution,	Monongahela,	Manhattan,
Huron,	Montauk,	Ossipee,
Cohasset,	Nantucket,	Rose,
Leyden,	New Hampshire,	Saugus,
Ohio,	Passaic,	Swatara,
Ossipee,	Pinta,	Independence,
Plymouth,	Powhatan,	Lackawanna,
Swatara,	Jean Sands,	Pensacola,
Vandalia,	Despatch,	Portsmouth,
Glance,	Supply,	Benicia,
Mayflower,	Tallapoosa,	Saco,
Quinnebang,	Wyoming,	Kearsarge,
Ranger,	Adams,	Yantic,
Sea Weed,	Alliance,	Palos,
St. Louis,	Brooklyn,	Michigan,
Alarm,	Canandaigua,	Richmond,
Alert,	Catskill,	Franklin.
Constellation,	Gettysburg,	

Vessels whose names appear more than once have been repaired at different navy-yards.

In submitting the estimates for appropriations, I beg leave to say that they do not cover the cost of thoroughly repairing all of the vessels which have been surveyed and found necessary to repair, but those only whose services are absolutely wanted for cruising purposes in time of peace, and for the completion of repairs to the double-turreted iron-clads.

The reports made by the proper officers after a thorough and careful survey upon vessels requiring repairs show more conclusively than any

reports heretofore made the great cost and loss to the Government arising from the use of unseasoned materials in the building and repair of vessels of war; *e. g.*, the *Yantic*, repaired in 1870, and completed in 1872, was made equally good as a new vessel in every respect. The materials used in the repairs were only partially seasoned, and after three years and six months' service she was reported so rotten that, if brought to the United States at all, a favorable season must be chosen, or she would not be able, through weakness, to safely make the voyage. The *Yantic* is only one of a large number of vessels which show the same result, and when compared with the durability of the *Franklin* and other vessels built of well-seasoned materials, the loss to the Government is surprisingly great. It is a source of gratification to know, in view of the above facts, that there is now on hand a large supply of good materials, which, in a short time, will be in condition to be used in the building or repairing of vessels, and which will warrant their durability and long usefulness.

Of the eight vessels authorized by act of Congress to be built, four have been put in commission and are at sea, and the remainder will be ready as soon as other vessels requiring repairs are put out of commission, from which crews may be obtained. These vessels, which were built by designs from this bureau, upon conditions decided upon by the chiefs of the respective bureaus, and with your approval, have, after a thorough trial at sea, given entire satisfaction, and have exhibited all of the good qualities expected of them. The *Trenton*, one of the vessels authorized to be built, will soon go into commission, and no doubt will meet the wants of the Navy for vessels of her class. This vessel was designed for a new type of war-vessels which were required for flag-ships. The points desired were good speed, increased fighting-power, handiness, and steady platform. The engines, designed by the Bureau of Steam-Engineering, have been tested, and show the power and compactness contemplated and desired in carrying out the above object. Vessels of this type will be superior in speed, in handiness, in fighting-power, and can be kept in commission at much less expense than vessels of the *Franklin* class. Taking in view the great advantage to the Government in having such vessels in service, I respectfully recommend the construction of five (5) more of the *Trenton* class.

Since my last report, the *Marion* and *Vandalia*, of the *Swatara* class, which were remodeled by designs from this bureau, with engines designed by the Bureau of Steam-Engineering, have been put into commission, and have made a passage to Europe. The reports of the performances of these vessels are very strong in praise of their superior qualities, and of being of the proper class for cruising-ships. More of the same class will be much needed ere they can be built, and I earnestly recommend that an appropriation be made for commencing the construction of five (5) vessels of that class.

The iron-clad vessels, of which fourteen (14) have been thoroughly repaired and so changed that, from being incapable of going or keeping to sea during rough weather, and of very imperfect and unreliable arrangements for fighting purposes, have been made perfectly sea-worthy, and of good facilities for working the turrets and guns, and have been furnished with all modern improvements.

The four double-turreted iron-clads are under repairs, and the improvements made have changed their wooden into double bottoms and iron hulls; increased their armor plating from five (5) inches laminated iron to seven (7) inches of solid plate, and thereby their shot-resistance to more than 100 per cent.; their free-board and capacity for carrying fuel

and stores by a large percentage, and their steam-power sufficient to give them a speed of ten (10) knots.

The repairs upon the iron-clad Puritan are well advanced; the improvements made are a change in the form of the hull, by which her capacity has been increased sufficient to lessen her draught of water about five (5) feet, and allow an increase of steam-power to produce a speed of twelve knots; an increase of thickness of armor from seven (7) inches of laminated to twelve (12) inches of solid-plate iron; and increase of free board sufficient to work her guns in any kind of weather, and the attachments of a steam-steering and capstan-apparatus. She is provided with two turrets instead of one, with four (4) 41-ton rifled, instead of two (2) 15-inch smooth-bore, guns of 25 tons. These improvements to the iron-clad vessels of the Navy, made by your directions, give the Government an iron-clad fleet of tenfold more power than it ever had before, and one vessel, at least, in many respects superior to the well-known English iron-clad Devastation. These vessels, when completely repaired, will be quite sufficient to meet all of the wants of the Government for an iron-clad fleet, especially as the time is fast approaching when such vessels for war purposes will be superseded by other more powerful instruments of warfare. The above five iron-clads, composing the heavy armor-plated vessels of the Navy, would be the first wanted in any naval warfare, and are indispensable for the protection of our large cities. Had the estimated amount called for in the last report been appropriated, these vessels would have been completed and made ready for sea by another fall. The importance of having them in readiness for service, and especially in the present aspect of foreign affairs, must be admitted by every intelligent person at all familiar with the subject, and for that purpose I earnestly and respectfully recommend that the sum of one million five hundred and fifty thousand dollars (\$1,550,000) of the amount estimated for be appropriated and made available for immediate use in preparing these five (5) iron-clads for service.

I beg leave herewith to inclose a statement showing the condition of all the vessels in the Navy on the 1st of January, 1869, with the particular duties performed by each since that time.

I am, very respectfully, your obedient servant,

I. HANSCOM,  
*Chief of Bureau.*

Hon. GEORGE M. ROBESON,  
*Secretary of the Navy.*

*Estimates of appropriations required for the service of the fiscal year ending June 30, 1875,  
by the Bureau of Construction and Repair.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1875.
<b>A.—SALARIES.</b>		
Chief clerk, per act of August 15, 1876, (Stat. at L., p. 161).....	\$1,800	
Draughtsman, per act of August 15, 1876, (Stat. at L., p. 161).....	1,800	
One clerk of class four, per act of August 15, 1876, (Stat. at L., p. 161).....	1,800	
One clerk of class three, per act of August 15, 1876, (Stat. at L., p. 161).....	1,600	
One clerk of class two, per act of August 15, 1876, (Stat. at L., p. 161).....	1,400	
One messenger, per act of August 15, 1876, (Stat. at L., p. 161).....	840	
One laborer, per act of August 15, 1876, (Stat. at L., p. 161).....	720	
One clerk of class three, (submitted).....	1,600	
One clerk of class two, (submitted).....	1,400	
	<b>12,960</b>	<b>\$2,960</b>
<b>CONTINGENT.</b>		
Stationery and miscellaneous items, (appropriated).....	800	40
<b>B.—CONSTRUCTION AND REPAIR OF VESSELS.</b>		
Preservation of vessels on the stocks and in ordinary: purchase of materials and stores of all kinds; labor in navy-yards and on foreign stations; preservation of material; purchase and repair of tools; wear, tear, and repair of vessels afloat, and general maintenance of the Navy; incidental expenses, advertising, and foreign postages; and for completing and making entirely ready for sea the five double-turreted iron-clads already in hand and in process of complete repair, (appropriated).....	<b>3,300,000</b>	<b>1,754.00</b>

### No. 11.—MARINE CORPS.

No. 97.]

UNITED STATES MARINE CORPS,  
COMMANDANT'S OFFICE,  
Washington, D. C., October 25, 1876.

SIR: I respectfully forward to the Department, in duplicate, my annual report on the condition of the Marine Corps.

I have the honor to be, very respectfully, your obedient servant,  
J. ZEILIN,  
Brigadier-General and Commandant.

Hon. GEO. M. ROBESON,  
Secretary of the Navy, Washington, D. C.

HEADQUARTERS MARINE CORPS,  
Washington, D. C., October 25, 1876.

SIR: In submitting the required annual report of the condition of the Marine Corps, I have the honor to state that at the present time there are 1,871 enlisted men in service, of which number 989 are on board vessels in commission and 882 at the several shore-stations.

As there have been fewer vessels in commission than usual since July last, the strength of the corps has been permitted to fall below its legal complement; but, as recruits are offering very freely, it could in a few days be filled up to its proper standard, should necessity require it. The duties of that portion of the corps stationed at the several navy-yards being confined exclusively to guarding the public property, leaves little

to report but the fact that these duties have been so performed as to receive the approbation of the commandants of the respective stations, and that at the usual inspections the troops themselves were found in excellent condition, leaving nothing to be desired in their equipment, drill, or discipline. Within the present year the detachment of marines on duty at the navy-yard at Pensacola was withdrawn by order of the Department, in consequence of the continued unhealthfulness of that station, and the men incorporated with the command at Norfolk, Va., where they were most needed at the time. Upon the sale of the navy-yard at Philadelphia, the marines stationed at the barracks there were removed to League Island, and quartered on board the ship *St. Louis*. This vessel was in commission at the time, under the command of a commander of the Navy, and the placing of this force of marines under his command, it was considered, would be but for a short period. Yet this arrangement still continues. It is, I believe, the first time in the history of our Navy that a body of marines intended exclusively for guard-duty on shore at a navy-yard was ever placed under the immediate command of a Navy officer, and I allude to the subject again with the hope that the Department may soon be enabled to designate some old vessel where this detachment can be placed under the control of its own officers, under the regulations of the Navy providing for the government of marines at the several navy-yards.

As I have but a few days longer to remain in active service at the head of the corps, it may seem out of place for me to make any official recommendation as to its future government or welfare, yet as it is thought probable that some measure will be brought to the attention of Congress, at its coming session, with a view to a re-organization of the corps, I will be pardoned perhaps for desiring to place on record my firm conviction, resulting from forty-five years of active service, that the present organization of the Marine Corps is the best that can be devised, and that it has hitherto fully met the requirements of the naval service and the country.

The testimony given by all the Navy officers summoned before the Naval Committee in relation to the Marine Corps was to the effect that it was a useful branch of the naval service, and could not be dispensed with; but some of these officers, of high rank and eminent service, were of opinion that its present organization should be changed; that its staff corps should be abolished, and indeed that the corps be entirely officered by Navy officers, and its services confined exclusively to naval operations. Against these latter views I would record my earnest dissent.

The Marine Corps, as established by the act of July 11, 1798, was expressly declared to be "in addition to the present military establishment;" and section 12 of that act provides "that it shall at any time be liable to do duty in the forts and garrisons of the United States on the sea-coast, or any other duty on shore, as the President at his discretion shall direct." The organization then given has existed ever since; and in every war that has occurred within this long period the services of the Marine Corps have been required on land with the Army, as well as on board ship, and in naval enterprises.

The Marine Corps of the United States was organized after that of the royal marines of Great Britain—a corps for over two hundred years eminently distinguished for its service on land under command of its own officers as well as for its legitimate duty with the navy. The proud motto of this royal corps, "*Per mae, per terram*," so well known all over the world, was authorized by the Navy Department to be placed

on the flag of the United States Marine Corps in English words, "By sea and land," in commemoration of our service with the Army in the field during the war with Mexico. The land service of our corps forms a bright page in its history, and it cannot be that the country desires, by a change of its organization, to lessen its usefulness and destroy its *esprit de corps* by confining its services hereafter to purely naval operations.

My object in referring to this matter is with the hope that the Department may coincide with me in the views taken, and should the subject be thought worthy of consideration, to recommend to Congress that the present organization of the corps be retained.

I am, very respectfully, your obedient servant,

J. ZEILIN,

*Brigadier-General and Commandant.*

Hon. GEO. M. ROBESON,  
*Secretary of the Navy.*

HEADQUARTERS MARINE CORPS,  
*Washington, D. C., August 14, 1876.*

SIR: I respectfully forward to the Department, in duplicate, "estimates of appropriations for the quartermaster's department, United States Marine Corps," for the fiscal year ending June 30, 1878.

I also inclose a letter from the quartermaster in relation to the estimates.

I have the honor to be, very respectfully, your obedient servant,

J. ZEILIN,

*Brigadier-General and Commandant.*

Hon. GEO. M. ROBESON,  
*Secretary of the Navy, Washington, D. C.*

HEADQUARTERS MARINE CORPS,  
QUARTERMASTER'S OFFICE,  
*Washington, D. C., August 12, 1876.*

SIR: I have the honor to submit herewith estimates of appropriations required for the service of the fiscal year ending June 30, 1878, by the quartermaster's department, Marine Corps.

These estimates vary from those submitted for fiscal year ending June 30, 1877, as follows:

Provisions, decreased.....	\$15,545.35
Clothing, decreased.....	8,722.00
Fuel, decreased.....	1,391.00
Military stores, decreased.....	1,000.00
Repair of barracks, decreased.....	5,000.00
Forage, decreased.....	1,000.00
Contingencies, decreased.....	5,000.00

The aggregate amount of these estimates is \$37,658.35 less than that asked in estimates of previous year.

I am, very respectfully, your obedient servant,

W. B. SLACK,

*Quartermaster Marine Corps.*

Brig. Gen. J. ZEILIN,  
*Commandant Marine Corps,  
Headquarters, Washington, D. C.*



*Estimates of appropriations required for the service of the fiscal year ending June 30, 1878, by the quartermaster's department of the United States Marine Corps.*

Detailed objects of expenditure, and explanations.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1877.
<b>PROVISIONS.</b>		
1,200 non-commissioned officers, musicians, privates, and washerwomen, 365 days, one ration per day, 438,000 rations, at 22 cents per day, is .....	\$96,360 00	\$90,000 00
<b>CLOTHING.</b>		
2,000 non-commissioned officers, musicians, and privates, at \$38.04 per annum, (actual cost per contracts 1875-'76,) is \$76,080; and 400 overcoats, at \$10.37 each, \$4,148, is .....	80,148 00	80,000 00
<b>FUEL.</b>		
4,194 cords of wood, as follows: one brigadier-general, one colonel, two lieutenant-colonels, four majors, three staff-majors, twelve captains, two staff-captains, fifteen first lieutenants, fifteen second lieutenants, twelve hundred non-commissioned officers, musicians, privates, and washerwomen, six hospitals, one armory, five mess-rooms for officers, sixteen offices for commandant and staff and commanding officers of posts, nine rooms for officers of the day, nine guard-rooms at barracks and navy-yards, three stores for clothing and other supplies. One-fourth additional on 2,400 cords, quantity supposed to be required in latitude north 36 degrees from October 1 to April 30, 600 cords, amounting in all to 4,194 cords, which, at \$6.50 per cord, is .....	27,261 00	25,000 00
<b>MILITARY STORES.</b>		
Pay of mechanics, repair of arms, purchase of accouterments, ordnance stores, flags, drums, fifes, and other instruments for bands .....	9,000 00	5,000 00
<b>TRANSPORTATION AND RECRUITING.</b>		
Transportation of troops and expenses of recruiting .....	8,000 00	5,000 00
<b>REPAIR OF BARRACKS.</b>		
Portsmouth, N. H., Boston, Mass., Brooklyn, N. Y., Annapolis, Md., headquarters Washington, D. C., navy-yard, Washington, D. C., Gosport, Va., Mare Island, Cal., and for rent of offices where there are no public buildings .....	15,000 00	5,000 00
<b>HIRE OF QUARTERS.</b>		
Hire of quarters for officers where there are no public buildings .....	16,000 00	16,000 00
<b>FORAGE.</b>		
Forage for public horses and the authorized number of officers' horses .....	5,000 00	5,000 00
<b>CONTINGENCIES.</b>		
For freight, ferrriage, toll, cartage, per diem for constant labor, funeral expenses of marines, stationery, telegraphing, apprehension of deserters, &c., oil, gas, candles, repair of gas and water fixtures, water-rent, barrack-furniture, furniture for Government houses and offices, packing-boxes, bed-sacks, wrapping-paper, oil-cloth, crash, rope, twine, carpenters' tools, tools for police purposes, purchase of fire-extinguishers, purchase and repair of hose, repairs to public carry-all, purchase and repair of harness, purchase and repair of hand-carts and wheelbarrows, purchase and repair of cooking stoves, ranges, &c., stoves where there are no grates, gravel, &c., for parade grounds, repair of pumps, and for other purposes .....	25,000 00	20,000 00
<b>PRINTING.</b>		
For printing and binding, to be executed under the direction of the Government Printer .....	5,000 00	.....

*Estimates of appropriations required for the service of the fiscal year ending June 30, 1877  
by the paymaster of the United States Marine Corps.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the fiscal year ending June 30, 1877.
<b>PAY OF OFFICERS, NON-COMMISSIONED OFFICERS, MUSICIANS, PRIVATES, AND OTHERS OF THE UNITED STATES MARINE CORPS.</b>		
1 brigadier-general, commandant.....	\$5, 500	
1 colonel.....	4, 500	
2 lieutenant-colonels.....	8, 000	
1 lieutenant-colonel, retired, (Rev. Stat., p. 271, sec. 1596).....	3, 000	
1 adjutant and inspector, 1 quartermaster, and 1 paymaster, (sec. 1623).....	10, 500	
4 majors, per act of June 30, 1834, (4 Stat. at L., p. 713, sec. 4, 5).....	13, 750	
3 majors, retired, per act of March 2, 1847, (9 Stat. at L., p. 155, sec. 3).....	7, 500	
2 assistant quartermasters, per act of August 5, 1854, (10 Stat. at L., p. 556, sec. 1).....	5, 400	
1 assistant quartermaster, retired, per act of February 2, 1857, (11 Stat. at L., p. 163, sec. 1).....	2, 100	
20 captains, per act of July 17, 1862, (12 Stat. at L., p. 594, sec. 2).....	46, 800	
3 captains, retired, per act of June 30, 1864, (13 Stat. at L., p. 144, sec. 1).....	4, 453	
30 first lieutenants, per act of March 3, 1865, (13 Stat. at L., p. 467, sec. 1).....	53, 250	
1 first lieutenant, retired, per act of July 28, 1866, (14 Stat. at L., p. 334, sec. 13).....	1, 125	
30 second lieutenants, per act of July 28, 1866, (14 Stat. at L., p. 337, sec. 37).....	38, 100	
2 second lieutenants, retired, per act of March 2, 1867, (14 Stat. at L., p. 422, sec. 1).....	2, 100	
1 leader of the band, per act of July 15, 1870, (14 Stat. at L., p. 157, sec. 7).....	948	
1 sergeant-major, 1 quartermaster-sergeant, and 1 drum-major, per act of January 18, 1875, (18 Stat. at L., p. 301, sec. 1).....	1, 060	
50 first sergeants, Navy Regulations.....	16, 200	
140 sergeants, per act of July 18, 1876.....	31, 560	
180 corporals.....	35, 400	
30 musicians of the band.....	9, 996	
96 drummers and fifers.....	17, 736	
1, 500 privates.....	270, 000	
10 clerks and 2 messengers.....	10, 000	
Payments to discharged soldiers for clothing undrawn.....	20, 000	
Transportation of officers traveling without troops.....	5, 000	
	<b>\$624, 000</b>	<b>\$624, 000</b>

Respectfully submitted,

HEADQUARTERS MARINE CORPS,  
Paymaster's Office, September 9, 1876.

J. C. CASH,  
Paymaster United States Marine Corps.

HEADQUARTERS MARINE CORPS,  
Washington, D. C., October 20, 1876.

SIR: I respectfully inclose herewith letter of Maj. William B. Slack, quartermaster United States Marine Corps, with schedule in duplicate of proposals received by the quartermaster's department for the supply of rations, fuel, clothing, &c., to the Marine Corps during fiscal year ending June 30, 1877.

I have the honor to be, very respectfully, your obedient servant,

J. ZEILIN,  
Brigadier-General and Commandant.

Hon. GEO. M. ROBESON,  
Secretary of the Navy, Washington, D. C.

HEADQUARTERS MARINE CORPS,  
QUARTERMASTER'S OFFICE,  
Washington, D. C., October 19, 1876.

SIR: I have the honor to submit herewith, to be forwarded to the honorable Secretary of the Navy, schedules in duplicate of proposals

received by the quartermaster's department for the supply of rations, fuel, clothing, &c., to the Marine Corps during the fiscal year ending June 30, 1877.

I am, sir, very respectfully, your obedient servant,

W. B. SLACK,

Quartermaster Marine Corps.

Brig. Gen. J. ZEILIN,

Commandant Marine Corps, Headquarters.

*Abstract of offers received for furnishing fuel, rations, and supplies to the United States Marine Corps under the cognizance of the Quartermaster's Department.*

[Offers for fuel under advertisement May 24, 1876.]

Stations.	Bidders.	Wood, per cord.	Coal, per ton.
Portsmouth, N. H .....	Hill & Stiver .....	\$8 25	\$7 25
	James McCudden .....	11 00	12 00
	Peters Bros. ....	13 50	8 97
	Russell & Odion .....	7 25	7 35
	W. H. Sise .....		7 25
	H. A. Mathes .....	7 50	
	C. E. Walker & Co .....	8 50	*7 00
Charlestown, Mass .....	Samuel G. French .....	13 00	8 90
	N. F. Mathes .....	*7 00	
	Peters Bros. ....	13 50	8 70
	Samuel Knight .....	*8 00	*6 89
	Samuel G. French .....	13 00	8 90
	Peters Bros. ....	12 50	7 67
	Albert F. Nathen .....		*5 90
Philadelphia, Pa .....	Samuel G. French .....	*7 19	6 23
	Peters Bros. ....	12 50	
	James J. Conrery .....	*7 45	*7 50
	Samuel G. French .....		7 50
	Peters Bros. ....	9 90	7 67
	Samuel G. French .....		7 90
	N. L. Fowler .....	5 43	6 35
Washington, D. C .....	John McElroy .....	5 58	6 15
	Johnson Bros. ....	*4 90	*6 00
	John Miller .....	5 17	6 15
	Robert J. Neely .....	4 85	6 95
	Peters Bros. ....	*4 47	*6 19
	do .....	13 50	
	N. L. Fowler .....	6 90	
Annapolis, Md .....	John Miller .....	*6 00	
	J. O'Neill .....	4 75	
	M. G. Ynlestra .....	4 50	
	H. McHatton .....	*4 50	
	William Walker .....	11 35	24 25
	A. Powell .....	11 87	24 00
	Arthur M. Ebbetts .....		*18 90
Pensacola, Fla .....	Samuel G. French .....		24 20
	N. F. Mathes .....	*10 90	22 75
Mare Island, Cal .....			

\* Accepted.

[Offers for rations under advertisement May 24, 1876.]

Stations.	Bidders.	Rations, per hundred.
Portsmouth, N. H.	Peters Bros .....	\$21.50
	H. W. Hall .....	12.30
	N. F. Mathes .....	21.40
	John C. Gilbert .....	20.00
Charlestown, Mass.	Peters Bros .....	20.50
	H. W. Hall .....	12.30
	N. F. Mathes .....	21.40
	John C. Gilbert .....	20.00
Brooklyn, N. Y.	Peter Higgins .....	20.50
	Peters Bros .....	19.70
	H. W. Hall .....	12.45
	John C. Gilbert .....	19.50
Annapolis, Md.	Peters Bros .....	19.30
	H. W. Hall .....	19.25
	Kimberly Bros .....	24.00
	Ryon & Earnshaw .....	24.00
	John C. Gilbert .....	24.00
Washington, D. C.	Peters Bros .....	19.40
	H. W. Hall .....	15.00
	Ryon & Earnshaw .....	15.00
	John C. Gilbert .....	16.00
Gosport, Va.	Peters Bros .....	15.00
	G. & R. Barrett .....	21.00
	John O'Neill .....	30.00
	H. W. Hall .....	15.00
	Taylor & Loyall .....	27.00
	David F. Keeling .....	24.00
	Kimberly Bros .....	18.00
Pensacola, Fla.	Russell & Hall .....	24.00
	H. W. Hall .....	12.00
	M. G. Yniestra .....	13.00
	Kimberly Bros .....	24.00
	N. F. Mathes .....	22.00
	Hugh McHatton .....	30.00
Mare Island, Cal.	J. A. McInnis .....	23.00
	H. W. Hall .....	24.00
	N. F. Mathes .....	22.00

\* Accepted.

[Offers for supplies under advertisement dated August 8, 1876.]

Classes.	Bidders.	Amount.
Class No. 1.—Kersey and cloth .....	B. Y. Pippey, agent .....	\$21.40
	Wilson & Bradbury .....	19.00
	Peter Higgins .....	24.00
Class No. 2.—Flannels, &c. ....	B. Y. Pippey, agent .....	9.10
	Wilson & Bradbury .....	9.20
	Peter Higgins .....	11.30
	William Matthews .....	11.70
	Collady, Trent & Co., (socks) .....	15.00
	do. ....	14.00
Class No. 3.—Linens, &c. ....	B. Y. Pippey, agent .....	5.00
	Wilson & Bradbury .....	5.70
	William Matthews .....	6.10
Class No. 4.—Uniform caps, &c. ....	C. F. Bush .....	4.30
	Horstmann Bros. & Co. ....	5.00
	James G. Davis & Co. ....	5.00
	Walton Bros. ....	5.00
Class No. 5.—Military equipments .....	Horstmann Bros. & Co. ....	1.40
	Walton Bros. ....	2.00
	Paul J. Field .....	2.00
	G. L. Wild & Bro. ....	2.00
Class No. 6.—Shoes .....	Walton Bros. ....	12.00
	C. R. Williamson & Son .....	10.30
	Jacob Reodel & Son .....	10.30
	John Mundell & Co. ....	10.30
Class No. 7.—Cartridge-boxes, &c. ....	Horstmann Bros. & Co. ....	1.00
	James G. Davis & Co. ....	2.00
	Walton Bros. ....	2.00
Class No. 8.—Making and trimming clothing ..	Jacob Reed .....	14.00
	Robert S. Gould .....	1.00
	Seth C. Keys .....	1.00
	Abraham Thorp .....	12.00

\* Accepted for part of a class.

† For part of a class.

; Accepted entire class.

HEADQUARTERS MARINE CORPS.

Quartermaster's Office, Washington, October 19, 1876.

W. B. SLACK.  
Quartermaster Marine Corps.

No. 12.—REPORT OF PROFESSOR EDWARD S. HOLDEN ON  
ASTRONOMICAL INSTRUMENTS.UNITED STATES NAVAL OBSERVATORY,  
*Washington, November 9, 1876.*

SIR: I have the honor to transmit herewith a report on the astronomical instruments of the loan collection of scientific apparatus at the South Kensington Museum, London, and accompanying photographs,\* made by Prof. Edward S. Holden, United States Navy, in pursuance of a special order from the Department, dated June 1, 1876.

Very respectfully, your obedient servant,

C. H. DAVIS,  
*Rear-Admiral, Superintendent.*

Hon. GEO. M. ROBESON,  
*Secretary of the Navy, Washington.*

*Report upon the astronomical instruments of the Loan Collection of Scientific Instruments at the South Kensington Museum, 1876, by Edward S. Holden, Professor, United States Navy.*

*To the honorable the Secretary of the Navy, Navy Department :*

SIR: On the 2d of June, 1876, I received the following order :

NAVY DEPARTMENT, WASHINGTON, June 1, 1876.

SIR: The Department desires to have an officer at the South Kensington Loan Collection of Scientific Instruments at London, to examine and report upon it. You are hereby directed to proceed without delay to London for this purpose, and on your arrival you will present yourself to the presiding officer of the Loan Committee and communicate these instructions. On the close of the exhibition you will return to your present station.

I am, very respectfully,

GEO. M. ROBESON,  
*Secretary of the Navy.*

Prof. EDWARD S. HOLDEN,  
*United States Navy, Washington, D. C.*

On the 10th of June I sailed from New York, arriving at Liverpool June 19, where I spent two days, visiting the observatory of Liverpool under the charge of John Hartnup, esq., F. R. A. S., and studying the systems of distributing public time, and of rating chronometers with respect to temperature, which are now practiced at that observatory. On the 21st of June I arrived at London, where I at once reported, as directed by my instructions, to the presiding officer of the loan committee. The official reply to the communication of my orders is annexed hereto, marked "B." [Omitted.] On the 6th of September I left London for Liverpool, whence I sailed for New York on the 7th, arriving on the 19th, and on the 21st of September I reported to the commanding officer of the Naval Observatory for duty.

During my stay in London, I was occupied in making a minute and detailed study of the astronomical instruments of the exhibition, and in connection with this I visited various observatories and workshops, where I found special instruments which were not represented in the exhibition, or where I was afforded special facilities for examination of such. I visited the observatories of Greenwich, Liverpool, Edinburgh, and the private observatories or laboratories of Dr. William Huggins, F.

\* Plates 1 to 21 are omitted, owing to cost and length of time required for their preparation.

R. S., F. R. A. S., etc., William Lassell, esq., F. R. S., F. R. A. S., etc., J. Maclean, esq., F. R. A. S., etc., E. B. Knobel, esq., F. R. A. S., etc., R. S. Newall, esq., F. R. S., F. R. A. S., etc., J. N. Lockyer, esq., F. R. S., F. R. A. S., etc., as well as the workshops or places of business of Cooke & Sons, Adam Hilger, Browning, and Troughton and Simms, mathematical and astronomical instrument makers. I also corresponded with Repsold and Brother, Hamburg, Breithaupt and Co., Cassel, and Lingke and Co., Freiburg, with reference to their instruments in the exhibition, and received from them photographs of their astronomical instruments and information in regard to them.

I desire to express officially my thanks to these gentlemen as well as to the authorities of the loan collection, particularly to J. Norman Lockyer, esq., and to Major Festing, R. E., to the Astronomer Royal, and to E. Dunkin, esq., F. R. S., of the Greenwich observatory, for many courtesies received at their hands.

I understood it to be the object of my mission to London to study the instruments of astronomy exhibited at the loan collection, with particular reference to new instruments and processes, and to important advances in the art of astronomical instrument making, for the special purpose of noting any novel forms or any improvements upon old forms which might be of use in the United States, either to the Naval Observatory, in astronomy, or to the Hydrographic Office and the Navy generally, in geodesy or navigation. As will be seen in the more special account of the exhibition, the newer forms of instruments were not, at least in the department of astronomy, completely represented. This is quite natural, as a truly *novel* form of instrument is often, nearly always, unique, and the only exemplars are to be found either in the workshops or in the hands of private investigators, who can ill spare them for public exhibition. The very complete catalogue of the exhibition published by direction of the council of the committee on education, supplies in general a tolerably full account of each instrument exhibited, and I have thought it proper to confine my written report to cases where additional information, only to be acquired by a personal inspection of the instrument in question, was necessary, and to an account of such improvements as I had the opportunity of seeing, which are not described elsewhere.

The system of distributing public time for the use of ship-masters and others, and the steps now taken by various countries to furnish accurate time to navigators, I have described more in detail on account of the very practical and valuable nature of the subject.

It must be remembered that although every facility was given me for the examination of the instruments in the exhibition, their true test will always be their actual performance in skilled hands; it was of course manifestly impossible to use these instruments as they would be used in the field, and I have therefore in some cases referred in detail to previously published accounts of their work.

#### I.—SKETCH OF THE FORMATION OF THE COLLECTION.

The first meeting of a committee of most of the leading men of science in England was held early in 1875, for the purpose of expressing publicly a desire that a temporary loan collection of scientific instruments and appliances and of the results of scientific research should be exhibited in London. This exhibition it was intended should partake somewhat of the nature of the *Conservatoire des Arts et Métiers* in Paris, so as to afford men of science and those interested in education an opportunity of seeing what was doing by other countries than their own (and also by their own) in the production of apparatus both for research and

for instruction. This could not fail to be of interest to several classes of persons—to scientific men themselves, to teachers of science, and to students. Great pains was taken to make the arrangement of the exhibition *topical*, by subjects, so that instruments of each class could be studied together.

In this way, any one who desired to study a special class of instruments would find them together, arranged in something like the historic order.

Invitations were sent by the authorities to the various governments and to public institutions and private men of science. In most cases this invitation was cordially responded to, and in most countries a sub-committee of its eminent men was appointed to forward the purpose of the exhibition; in nearly every case with the most gratifying results. Old and rare apparatus and instruments were sent from their repositories with cheerfulness, and were exhibited in London along with the modern forms to which the earlier instruments have given rise, so that in some cases the whole history of a subject, so far as it was to be learned from the instruments employed, was to be seen at a glance.

It is not necessary to mention all the striking appositions thus afforded; an example of them may be given in the fine exhibit of Italy, where the original telescope of Galileo, with which he discovered the phases of Venus, the satellites of Jupiter, the spots on the Sun, the constitution of the Milky Way, etc., was shown, along with many other pieces of ancient apparatus, the prototypes upon which modern science has built its instruments of precision. The absence of any exhibit from the Government of the United States was noticeable, and was to be regretted, particularly as the fine collection of scientific instruments, apparatus, and the products of research at the Government building of the International Exhibition at Philadelphia shows that in many branches we have already attained an honorable, and in a few a foremost, position.

In order to make the exhibition more fruitful, the managers of the loan collection caused to be printed two works of high importance. The first is a "Hand-book to the Special Loan Collection of Scientific Instruments," and consists of general essays by eminent men of science. The second is the extensive catalogue, to which the second section of this report may be considered in part a supplement. This catalogue contained a description of each of the instruments exhibited, and in many cases gave illustrative wood-cuts and diagrams, with examples of its use, and a brief history of the problem which it was designed to solve. The brevity of the present report is due to the general excellence and thoroughness of the catalogue. In order to utilize the exhibition to the utmost, daily lectures were given, official programmes of some of which are annexed, marked "A."

If these lectures were not sufficiently detailed to cover the peculiarities of special pieces of apparatus, "demonstrations" were given once or twice a week for each instrument, in which the instrument was elaborately explained and its working exemplified. Thus the special uses of each instrument were to be known, either by examination of it, from the catalogue, or from the "demonstration;" and the general relations of classes of instruments were sought to be explained in the lectures. It would, of course, be impossible, in any brief account of so large a collection, to give an adequate idea of its contents. This must be gained from the catalogue, which contains accounts of instruments relating to every branch of modern science. The instruments themselves completely filled fourteen or fifteen large rooms, and the second edition of

the catalogue contained 957 pages, one page referring often to many entries.

As far as can be judged, the special and peculiar merit of the exhibition was its exposition of the historical side of the various subjects. In many departments little was left to be desired in this direction. In such a subject as telegraphy, for example, the whole history was presented (with the exception of important American methods) from its foundation to the present day. Particularly in the department of chronometers and clocks a full exhibit was attained, in which, however, the admirable instruments of American makers, like Negus and Bond, were not seen. In many special pieces of apparatus, such as chronographs, sextants, field astronomical instruments, personal-equation machines, objectives, etc., the perfection of American instruments made their absence conspicuous to any one who was acquainted with them. I have annexed a list of the foreign visitors to the exhibition, marked "C," [omitted.]

## II.—ASTRONOMICAL AND NAUTICAL INSTRUMENTS AND AUXILIARY APPARATUS.

In what follows I have brought together a portion of my notes on astronomical and nautical instruments, on domes for large telescopes, etc. The following section, taken in connection with the catalogue of the loan collection and with the photographs annexed, [omitted,] and also with published descriptions of instruments in the various scientific journals and annals of observatories, will give most of the information attainable from an examination of the loan-collection instruments. It cannot be too much insisted on, in the case of new instruments, that the true test of excellence is their success, after thorough trial, in the situations for which they are destined, and not their performance under exceptionally favorable conditions.

### *Equatorial Mountings.*

I. *Refractors.*—The accompanying photographs (numbers 3 to 7, inclusive) give a better notion of the styles of mounting adopted by the several makers than any description could do which was not aided by detailed wood-cuts. In this connection the various descriptions in the catalogue should be consulted. Figure 3 is a photograph of the new heliometer for the observatory of Strasburg. It was made by Repsold and designed by Winnecke. It is similar to those used on the Russian transit of Venus expeditions. The instrument can be used in any latitude from  $0^{\circ}$  to  $66^{\circ}$ . All movements can be controlled from the eye end. The slide bars of the objective move simultaneously on cylindric surfaces in opposite directions.

One of the most interesting models at the loan collection was one of the mounting, etc., of Mr. Grubb's new 27-inch refractor, which is intended for the Vienna observatory. It is not possible adequately to describe it without a number of cuts, but I condense from my notes sufficient data to make its general features understood. The *pier* is of two parts, A and B, both rectangular in cross-section, cast of iron, and hollow. The clock-work is placed within them. To the inclined top of B is bolted a heavy slab, C, of iron, for a bed plate. The *polar axis* (*p*) is inclosed in a hollow frustum of a cone, D, which is supported at its upper end by a flanged piece, E, the lower end of which is bolted to C. The model did not show a tail-screw to support the thrust of the polar



axis, and I presume this plan is not adopted. The upper bearing of the polar axis is relieved, as in the 26-inch Clark telescope at Washington, by a bent lever. The head of the polar axis carries a cubical box, inside of which are two Y's, in which the *declination axis* turns. One end of the declination axis terminates in a heavy cradle, into which the telescope is strapped by steel straps. The declination axis has 4 friction-rollers, two at each end of the counterpoise-levers; at the head of the polar axis are four friction-rollers, also for the declination axis. This system is somewhat complicated, and requires a model to understand fully its operation. The *declination circle* is arranged as at Washington. The hour circle is probably intended to go inside of D. The *sector* is large, and acted on directly by the *worm* from the clock. The system of slow motions, clamps, etc., are explained in the catalogue. There are four *finders*, one large one with a small one attached, and two at the side.

Fig. 4 is a photograph of a refractor of 9 inches aperture and 13 feet focus, by Repsold and Brother, Hamburg.

Fig. 5 is an 8-inch refractor, by Troughton and Simms, for the Melbourne observatory.

Figs. 6 and 7 represent a 6-inch refractor, by Cooke, of York.

These figures fairly represent the various European styles of mounting. For more detailed accounts, the descriptions of Figs. 3 and 4 may be consulted in the catalogue of the loan collection.

II. *Reflectors*.—The mountings of Browning, now well and favorably known, are used for most reflectors of ordinary size. I had an opportunity to test two of Browning's reflectors, of 8 and 15 inches aperture respectively, and the mounting seems to be in every way suitable and convenient.

For larger telescopes of this class a mounting may be used like that devised by Grubb, of Dublin, for the 4-foot reflector at Melbourne, (of which a model was exhibited at South Kensington,) like that of the new Paris 4-foot reflector, or, finally, in the form described by Lassell in *Memoirs of the Royal Astronomical Society*, volume xxxvi. Both the first forms have been pronounced satisfactory by high authority; the first showing in particular great steadiness and unusual convenience of manipulation. The third, as applied to Lassell's 2-foot telescope, I personally used on several occasions, and found it light, easy to manage, and convenient. For a much larger aperture I should be inclined to doubt its perfect steadiness.

### *Meridian-Circles.*

Fig. 1 is a photograph of the Strasburg meridian-circle, made by Repsold and Brother.

Fig. 2 is a view of a transit-circle now making by Troughton and Simms for the observatory of Glasgow, Missouri.

It is worthy of note that both these fine instruments are in most of their essentially new features modeled from the transit circle of Harvard College observatory, which was designed by the late Professor Winlock, and made by Troughton and Simms. Both have the cast-iron microscope bearers, which form so novel and important an invention. In the Strasburg instrument the axis is hollow and has at one end a lens of 2 inches aperture. In the focus of this at the other pivot is a plate, with a small hole in it, for controlling the position of the axis. A central illumination of the threads is secured by an illumination from a small mirror at the back of the objective. The eye and object ends are interchangeable. Nadir observations can be taken with the level on, and

also reflex observations from  $80^{\circ}$  to  $60^{\circ}$  nadir distance. It is 6 inches aperture, 6 feet focus, and has 2 feet circles of metal.

### *Portable Astronomical Instruments.*

The figures 8 to 12 are representations of portable astronomical instruments, mainly by Repsold and Brother, of Hamburg, whose instruments have deservedly attained the highest reputation for precision and for a kind of elegance not necessarily associated with precision. Their mechanical arrangements will well repay study.

Fig. 8 is a Repsold transit instrument suitable for use in any vertical plane. This instrument and the following ones are those in use in the field operations of the Russian and other geodetic surveys, and numerous proofs of their excellence could be cited from official reports.

Fig. 9 is the same transit instrument intended only for use in the meridian.

Fig. 10 is the portable vertical circle, which is essentially a theodolite of great perfection.

All the above instruments have a tube of only half the focal length of the objective, and all are provided with hanging levels, which constantly remain on the axes. The original idea of a telescope shortened in this way by reflecting the rays through the axis is due to Steinheil, of Munich. Steinheil's original instrument was exhibited at South Kensington, and also a larger example of it made by August Lingke and Co., of Freiburg, for Dr. Bruhns, director of the observatory of Leipzig. In this form the horizontal axis is itself the telescope, and the prism and objective are at one end of this axis, the ocular being at the other. A similar instrument is now making by Fauth and Co., of Washington. The principal danger to be anticipated in the one exhibited at South Kensington appeared to be a flexure of the tube from the effects of the clamp in zenith distance, and although this was foreseen by the makers, it remains to be seen from actual trial whether the means adopted to avoid such a flexure are adequate.

In the Repsold instruments (Figs. 8 and 9) it will be observed that the finding-circle is on the other end of the horizontal axis from the ocular, an arrangement which it would seem is slightly inconvenient, and by which not enough is gained to compensate for the additional labor of observing.

Fig. 11 is a portable transit of ordinary construction, by Repsold.

Fig. 12 is an alt-azimuth for astronomical use, by Troughton & Simms, and designed by Mr. Russell.

### *Geodetic and surveying instruments.*

Fig. 13 is a 2-foot theodolite, by Troughton and Simms.

Fig. 14 is a 2-foot theodolite, by Troughton and Simms.

Fig. 15 is an 18-inch theodolite, by Troughton and Simms.

Fig. 16 is an 18-inch theodolite, by Troughton and Simms.

Fig. 17 is a tachymeter, by Troughton and Simms.

Fig. 18 is a small 5-inch tachymeter, by Troughton and Simms.

Figs. 19, 20, and 21 are geodetic instruments, by Breithaupt and Co.

### *Objectives.*

I saw no objectives in process of manufacture in England. Unfavorable weather prevented me from making as careful an examination of

the qualities of the objective of 25 inches aperture belonging to R. S. Newall, esq., as I hoped for. The examination I was able to give it was mainly directed to the effect of the residual chromatic aberration or secondary spectrum upon the image of a bright object. The amount of secondary spectrum in this telescope of 25 inches aperture and 30 feet focus is, as far as I could judge, not greatly different from that in the Clark telescope at the Naval Observatory of 1 inch more aperture and 30 inches more focal length, which speaks well for the color-correction of the Cooke glass. It is worthy of remark that Dr. Huggins employs a thin layer of oil between the two glasses of his 15-inch Grubb refractor, with the object of diminishing the internal reflections of the incident light. I am not aware that this has been tried in the United States.

### *Speculums.*

The performance of the silver-on-glass speculums, made by With, for Browning, I had an opportunity of testing, (with an 8-inch speculum,) and in this case the star-images were neatly defined, showing no effect of flexure, as, indeed, in so small an aperture was to be expected.

By the personal kindness of Mr. Lassell, the maker and owner of many metal speculums of various apertures, from 4 feet down to 3 or 4 inches, I was enabled to test practically the efficiency of his system of counter-levers for removing flexure from speculums of large size. The system was applied to the celebrated speculum, of 2 feet aperture, with which Mr. Lassell has made his discoveries of two satellites of Uranus, a satellite to Neptune, and one to Saturn, and has prosecuted his important observations of nebulae.

I found that with fourth-magnitude stars, and below, the telescope might be turned from near the zenith to  $106^{\circ}$  of north polar distances quickly, without affecting the roundness of the images or of the diluted disks of stars.

The speculum metal made by Mr. Lassell possesses great advantages over that formerly employed by the two Herschels and Lord Rosse, since it is but little likely to tarnish. The surfaces of some small speculums which I saw were almost perfectly free from stain, although many of them were over twenty years old, and Mr. Lassell even produced some mirrors which had been boxed up for that length of time, which were almost entirely free of stain, except at the edges.

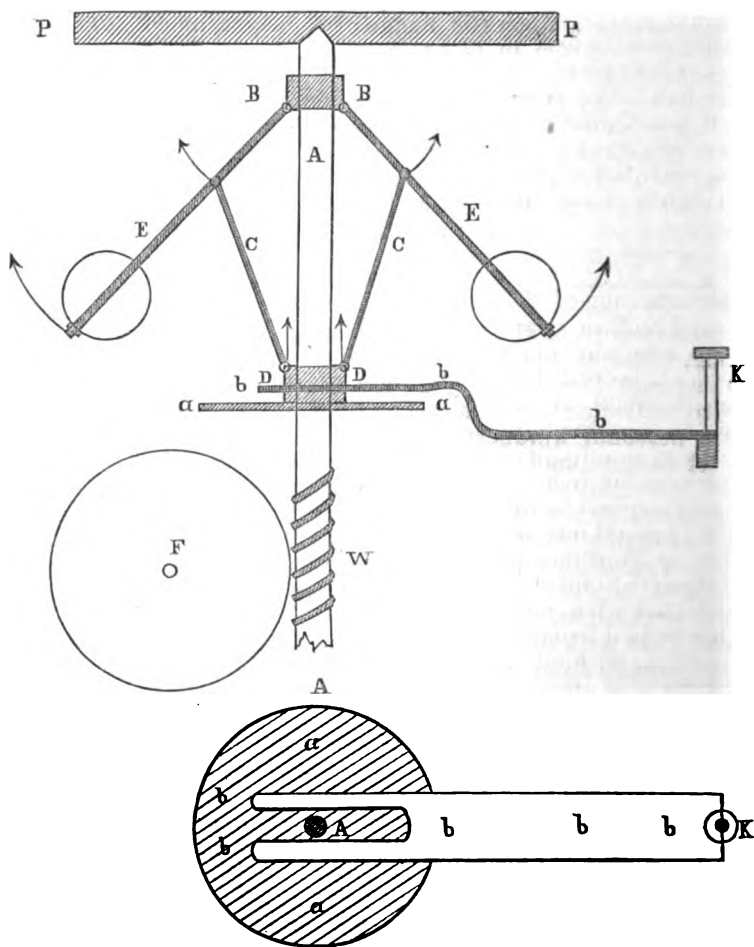
The metal employed by the Herschels and others required constant polishing, as we know, and it is extremely important that it should be known that it is possible to make a metal which will retain its lustre.

It has always been supposed that the speculum metal was inferior to glass, if for no other reason, because it required repolishing at short intervals, and in each repolishing there was great danger of losing the original figure, so that the labor of repolishing might easily become the labor of figuring a new mirror. It certainly is not generally known that this is not necessarily true, and I am not aware that any published reference to this fact has been made by Mr. Lassell.

### *Driving-clock contrived by William Lassell, esq.*

This is very simple in construction, and its action is as follows: The weight gives motion to the axis A, to which the collar BB is attached. As EE move upward, they carry with them the hinged arms CC. These lift the slipping-collar DD on the axis A. *aa* is a revolving plate, firmly attached to DD. As this rises it rubs against the fixed spring *bbb*, and

retards the motion. The screw *k* lifts the whole spring *bbb* bodily, for purposes of regulation. This form is interesting, as it was essentially



the one employed for the transit of Venus driving-clocks, and as a simple modification of it is used by Browning.

*Driving-clock devised by A. Hilger.*

The driving-clock devised by Hilger for the large siderostat exhibited by Colonel Campbell, is said to perform extremely well. The mechanical finish is certainly exquisite. It is a modification of the Watt governor, so that when the balls rise they act upon a slipping-jacket to the main axis, (which is, of course, vertical,) and by means of a system of bent levers alter the inclination of two large flat fans, in this manner changing the resistance. It is provided with several adjustments, by means of which it is intended that the variable resistance to the motion shall be brought within the regulating power of the fans. The action is too complicated to be explained without detailed wood-cuts.

*Equatorial driving-clock, controlled by a standard-clock, contrived by Thomas Grubb, esq., F. R. S., for William Huggins, esq., F. R. S.*

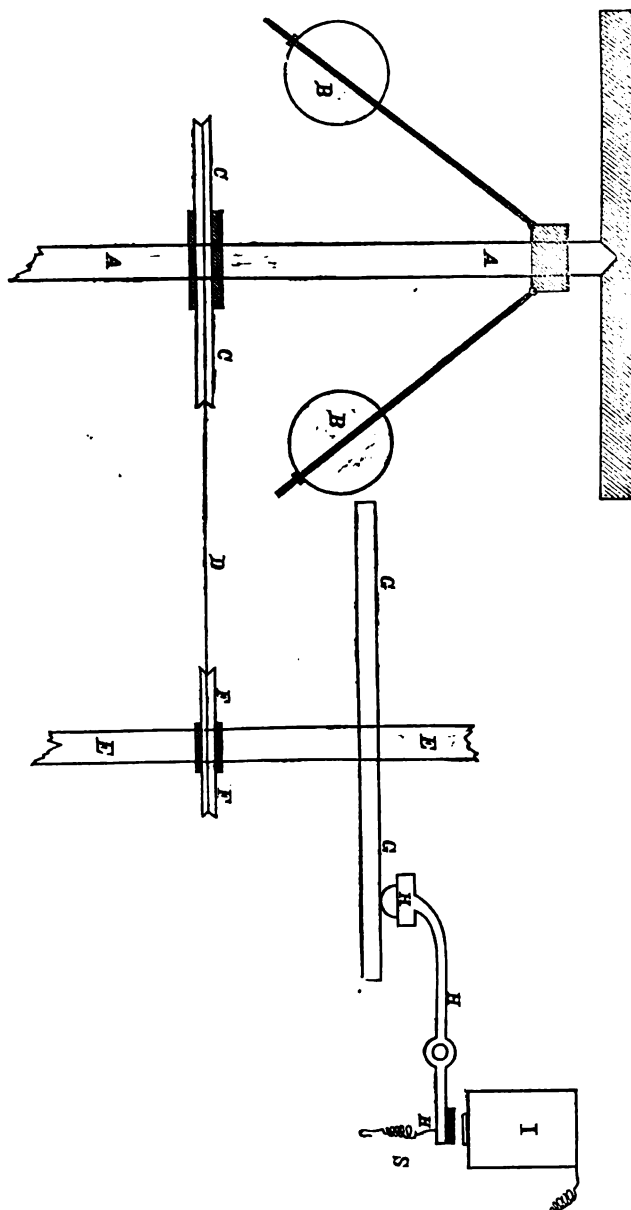
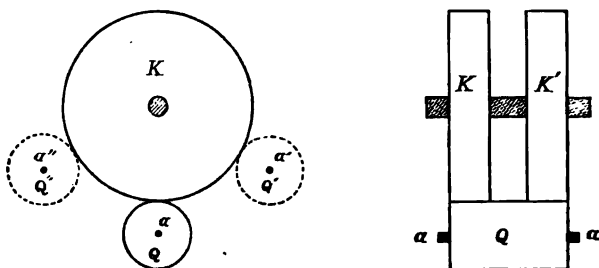


Fig. 1.

**Description.**—In Figure 1 motion is given to the main axis A A by the weight, and this motion is made approximately uniform by the governor B B. A A is connected with a second axis, E E, by the endless cord D, passing round the two wheels C C and F F. The axis E E carries a

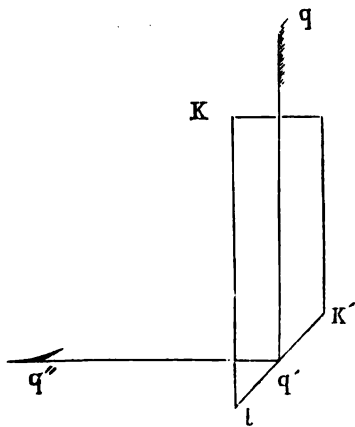
plate, G G, on which pressure is exerted by the lever H H H, which is controlled by the electro-magnet I. S is a coiled spring acting on H H H in opposition to I.

Fig. 2.



In fig. 2, K is a toothed wheel connected with the axis A A in such a way that when the driving-clock is moving correctly K revolves  $n$  times per minute. K' is a toothed wheel of the same number of teeth as K, which is driven by the standard (astronomical) clock  $n$  times a minute. In Dr. Huggins's observatory K' is driven by a pendulum controlled by the standard clock. Q is a pinion working into both the toothed wheels K and K'. It revolves on an axis,  $a a$ , which can itself move round the circumference of K in the circle K  $a a' a''$ . When K and K' have no relative motion, or when the driving-clock is performing correctly, Q stays at the lowest point,  $a$ , and the electro-magnet I, whose action is dependent on the position of Q, is inert. The driving-clock is so regulated as to run slightly too fast, and as K thus moves a little faster than K', the pinion Q moves upward in the direction Q  $a'$ , and excites the electro-magnet I. This causes a pressure by H H H on the plate G G, which retards the motion, which is again accelerated, and so on. Dr. Huggins' report on this clock, which has just been erected, is favorable.

#### *Bright-line micrometer.*



An ingenious bright-line micrometer has been devised by Hilger, optician, of London, which is decidedly the simplest and best of those now known for use in spectroscopes.

K K' l is a plate of glass, into which the light is thrown from  $q$ . This beam passes from  $q$  to  $q'$ , is reflected, and emerges, passing to  $q''$ . The surface K l is blackened, and a thin line parallel to K l is left transparent. This line shows bright in a dark field. The piece of glass may be made extremely small and mounted in a micrometer. This micrometer has worked well in spectroscopic observations, and is now in use at Greenwich and elsewhere.

#### *Chronometers.*

In the report of the Astronomer Royal to the board of visitors for 1875, we find an account of a supplemental mechanism, devised by Sir

George Airy himself, for attachment to chronometers, with a view of mechanically correcting chronometers for temperature. I quote from page 19 as follows: "I have long remarked that in ordinary good chronometers the freedom from irregularities depending on mechanical causes is most remarkable, but that, after all the efforts of the most judicious makers, there is in nearly every case a perceptible defect of thermal compensation. There is great difficulty in correcting the residual fault, not only because an inconceivably small movement of the weights on the balance-curve is required, but also because it endangers the equilibrium of the balance. To remedy this, I have introduced small supplementary weights carried by means of a supplementary bar, (rotating with stiff friction on the balance-staff,) at whose ends are very light springs, carrying the supplementary weights and constantly pressing them to the interior of the balance-curve. When the supplementary bar is so turned that the supplementary weights are near the end of the balance-curve, the compensation is large; when they are near the root of the balance-curve, it is small. The movement from one state to the other is so simple that probably an assistant of the observatory will be able to manage it, and it does not interfere with equilibrium. This arrangement has received the approval of some able chronometer-makers, and may perhaps with advantage be adopted generally."

In subsequent reports the astronomer royal speaks favorably of this device after trial, and at the present time all chronometers presented for the annual trial (and thus for purchase by the government) are required to be furnished with this additional compensation. It would seem that this is an important device, which it would be desirable might be carefully tried by American makers, since it seeks to correct by mechanical means the influence of temperature upon the rate, which it is the object of so many investigations and observatories to determine.

### *Spherometers.*

This instrument may properly be regarded as a valuable aid to the astronomer for measures of curvature of glass surfaces, etc., and Professor Harkness, United States Navy, has recently described an important application of it to the determination of the inequalities and irregularities of the pivots of transit instruments. As usually constructed, it is capable of measuring a distance of about  $\frac{1}{25000}$  of an inch or less. When quantities so small as this are to be measured, the chief difficulties consist in finding the precise value of each revolution of the micrometer-screw, and not only the true values of each *whole* revolution, but the amounts of those errors, which are sure to exist, which have a period of one turn of the screw. Lord Lindsay is now having an instrument of his kind made in which the periodic errors of the screw can be readily determined (or eliminated) according to a plan which I had myself proposed about the same time as Lord Lindsay.

Each of the three legs of the instrument is itself a micrometer-screw, in this case of 90 threads to the inch,) with a divided head, the main screw having 100 threads to the inch. By repeating a measure with the legs of the instrument at various settings, the periodic errors of the chief screw may be eliminated, or by suitable and obvious means these periodic errors may be determined once for all, and tabulated for subsequent use.

Several delicate spherometers are described in the catalogue, but all are of the old form, in which the periodic errors of the screw are extremely difficult to determine, and in which they cannot be eliminated.

*Domes for large telescopes.*

It is probable that for a large dome, over 40 feet in diameter, the spherical form will always be used, and I gave particular attention to structures of this class. Of the smaller turret-domes, that of Dr. Huggins is a model for convenience and lightness. The loan collection contained a working model of the frame-work of a steel dome made by Grubb, of Dublin, for the Vienna equatorial, (27 inches aperture and about 33 feet focus.) The frame-work is of trussed iron beams. Two constitute the main arches and embrace the slit. These are about 6 to 7 feet apart. Two perpendicular to these, and about the same distance apart, abut on them but do not cross them. Four others abut at the junction of the first four, making 12 *half* arches in all. The arrangement is somewhat peculiar, but is to be commended. Seven horizontal and circular bands of iron fastened to these beams allow the fastening of the sheets of steel. This dome will be erected in Vienna in 1877, and, if successful, its arrangements will be most convenient to follow in any future structures. An ingenious shutter of iron, counterpoised, is provided, which passes completely over the dome. Through the medium of several counter-weights the varying load to be lifted in opening the shutter is balanced by a varying counterpoise. When the shutter is half opened the counterpoise-weights do not act, they being at the lowest point of their fall; from this point until the shutter is fully opened the counterpoises are successively lifted, so that they are in position to begin the reverse process of closing the dome. I have been thus detailed in describing it, as the problem of providing a good covering, easily removed, for a large dome, is not an easy one, and as Mr. Grubb's seems to promise well.

The dome made by Mr. Newall is of iron, 40 feet in diameter, and works well, although the rotation is not so easy as it would have been had the "live-ring" system proposed by Mr. Grubb (and adopted in the large dome of the naval observatory) been used. Mr. Newall's dome is well known from photographs, and a detailed description of it is therefore unnecessary. Through Mr. Newall's kindness I have the dimensions of the various pieces. Its whole weight is only 10 tons; it is abundantly strong, and with the exception of the apparatus on which the dome rotates, it would serve well as a model for future structures. Mr. Newall has an ingenious plan (not carried out) for moving the dome by a caloric engine, the principal novelty of which consists in his arrangement for reversing the motion of the dome without reversing the engine.

### III.—TESTING CHRONOMETERS FOR TEMPERATURE AS PRACTICED AT THE LIVERPOOL OBSERVATORY.

Under direction and at the expense of the marine committee of the Mersey Docks and Harbor Board, (Liverpool,) an observatory has been long in operation under the charge of Mr. Hartnup, F. R. A. S., etc. Its objects are—

1st. Rating and testing chronometers. This is done free of charge for the chronometers of any vessel which has paid harbor and dock dues:

2d. Disseminating correct time by means of signals, so as to enable shipmasters, chronometer-makers, and others to rate their own instruments;

3d. Making meteorological and astronomical observations.

The main purpose of the observatory is to be useful to the shipping in the harbor and port, and it drops a time-ball, fires a time-gun, and reg



ulates various clocks in the city and on the docks for this object, so that any shipmaster is independent of the chronometer-makers.

This work has been continued for many years, and a large mass of statistics concerning the running of the chronometers of ships sailing out of Liverpool has been accumulated and partially discussed, and in the later years of its activity much attention has been paid to the question of determining for a given chronometer which has been rated at three different temperatures the rate at *any* temperature.

The importance of the investigation cannot be overestimated, and I have thought it proper to give some account of the successive steps taken in this direction and of the present condition of the inquiry.

In the earlier history of the observatory, its attention was confined to the *rating* of chronometers, and when any instrument was sent out with a given *correction* and *rate*, a record was kept of the fact.

On the return of the instrument to Liverpool every effort was made to find the *correction* and *rate* which was given at the foreign port, and in this way a vast amount of statistical information concerning the running of the chronometers of merchant-ships out of Liverpool was accumulated.

For access to these statistics, published and unpublished, and for a complete view of the methods adopted, I have to thank the courtesy of Mr. Hartnup and of his son, who are now in charge of the establishment. The following table is extracted from the report of the director for 1863, page 4.

The *first* horizontal column contains the length of the voyage in months; the *second*, the average error of longitude in geographical miles of the equator deduced from the means of 1,700 chronometers, and the remaining columns show the average error of the best ten instruments in one hundred, of the second best ten, &c. I have only taken so much of the table as would include a voyage of four months, since a vessel could hardly be without means of correcting her chronometer for a much longer time than this. We may fairly say that this table represents the danger which the merchant-ships of Liverpool actually were subjected to for many years on account of erroneous running of their chronometers, and because the sea-rates varied from the shore-rates. It must also be remembered that from this table all cases of vessels which were shipwrecked (on this and other accounts) are omitted, so that, no matter how impossible it may at first sight seem to be that such enormous errors existed, it is yet a matter of fact that the errors are *under* and not *over* stated.

Table showing error of longitude in geographical miles on the equator, deduced from 1,700 chronometers.

Length of voyage.	One month.	Two months.	Three months.	Four months.
verage error from 1,700 chronometers.....	6	14	23	33
verage error from the best 10 in 100.....	0	0	1	1
verage error from the second best 10 in 100.....	1	2	3	4
verage error from the third best 10 in 100.....	1	4	6	8
verage error from the fourth best 10 in 100.....	2	5	9	13
verage error from the fifth best 10 in 100.....	3	7	12	17
verage error from the sixth best 10 in 100.....	4	9	15	22
verage error from the seventh best 10 in 100.....	5	11	18	28
verage error from the eighth best 10 in 100.....	7	15	25	36
verage error from the ninth best 10 in 100.....	9	24	41	61
verage error from the worst 10 in 100.....	25	62	101	143

Before examining the table in detail, it is extremely important to remark that if the resulting "error in longitude" was caused simply by a difference between the *sea-rate* and *shore-rate*, the numbers in the top line should be in the proportion 1, 2, 3, 4; that is, for a voyage of two, three, etc., months, the "error of longitude" should be, in the average of so many cases, 2, 3, etc., times as great as the error for one month. These ratios, instead of being 1, 2, 3, 4, are 1, 2.33, 3.83, 5.50.

Nothing could show more plainly the fact, that not only did the *sea-rate* vary from the *shore-rate*, but that the *sea-rate* itself changed. The *principal* agent in causing the change of rate was change of temperature. Examining the table in detail, it becomes necessary to recollect that it is a matter of record that these actually were the errors of chronometers carried on a large number of ships sailing out of Liverpool. The average errors derived from no less than 1,700 chronometers are enormous, being as great as 33 miles for a voyage of four months.

Among the many vessels carrying these instruments were a large number going on long voyages to India, Australia, and South America, and in many cases these vessels would necessarily be between three and four months or more on the voyage, often without sighting land. It appears from this table that the average error to be *expected* on such a voyage and with such chronometers as they had (up to 1863) was no less than 33 miles! It is plain that no such errors are to be found in the chronometers used by our own naval vessels, nor were American merchant-vessels during the same period so badly provided for, but it is certain that English vessels were provided on the whole with extremely poor instruments.

Probably the chronometers in use in the United States Navy would all fall within the first three categories, and most of them within the first two.

Mr. Hartnup became early convinced of the necessity of testing his chronometers for the purpose of determining the effect of temperature upon their rates. For this purpose comparatively inexpensive apparatus was procured, by means of which the chronometers could be tested at 55°, 70°, and 85° F., these limits including the temperatures to which they would usually be exposed at sea. It soon became evident that these experiments were directly useful to chronometer-makers, and thus indirectly to ship owners and masters, as by the data which could be furnished a chronometer-maker was able to materially improve the compensation of his instruments. As an example of this I select a case from the report for 1869. A chronometer, supposed to be a very good one, was left at the observatory for thirty days, and tested at temperatures of 55°, 70°, and 85°, with results as exhibited below:

First period of 6 days:	rate = + 6.93;	temperature = 55° F.
Second period of 6 days:	= - 3.40;	= 70°.
Third period of 6 days:	= - 12.43;	= 85°.
Fourth period of 6 days:	= - 3.03;	= 70°.
Fifth period of 6 days:	= + 6.32;	= 55°.

It was again given to the maker and by him altered so that its rate should change as little as possible over a range of 30° F., by the aid of the data above given, and on its second trial the improvement was material, as may be seen.

First period of 6 days:	rate = + 1.78;	temperature = 55° F.
Second period of 6 days:	+ 1.05;	= 70°.
Third period of 6 days:	+ 0.18;	= 85°.
Fourth period of 6 days:	+ 1.12;	= 70°.
Fifth period of 6 days:	+ 1.78;	= 55°.

It is clear that had this chronometer been sent to sea in its first state, and without trial, it might have led to serious results. On a voyage from Liverpool to Rio in the spring of the year, for example, the ship might easily have rapidly passed from a mean temperature of about  $55^{\circ}$  to one of about  $85^{\circ}$  in a few days; and if no land was seen, there would have been no way of knowing that the rate had changed from  $+6^{\circ}.9$  to  $-12^{\circ}.4$  daily, a change of  $19^{\circ}.3$ , or about five miles daily.

It is plain that the observatory was of use in enabling the maker to reduce the difference between the rates at  $55^{\circ}$  and  $85^{\circ}$  so materially, but there still remains over, in the second trial, a difference of  $1^{\circ}.5$  in these rates. In the cases of six *good* chronometers these outstanding differences were  $0^{\circ}.07$ ,  $0^{\circ}.03$ ,  $2^{\circ}.62$ ,  $2^{\circ}.76$ ,  $3^{\circ}.26$ ,  $1^{\circ}.96$ ; in some serious, in others not.

The chronometer-maker can never apply the test in the first instance so conscientiously as it can be done in an astronomical observatory. And again, no matter how carefully his work is done, (and in modern chronometers of distinguished makers it is extremely well done,) he cannot by any means remove the influence of temperature upon the rate. He can approximate to it, but in no case can he be sure that a change of  $20^{\circ}$  in the temperature, to which his chronometer is exposed, will not seriously change its running. It becomes important, then, not only to aid the chronometer-maker in the first instance, and thus indirectly the navigator, by giving him the standard time, but to seek for some means of predicting, from observations of rate at three (or more) definite temperatures, what the rate will be at any given temperature. In the report for 1872 the following formula is proposed as the result of experience:

Let  $T$  be the temperature at which the chronometer has its maximum gaining rate; let  $R$  be this rate; let  $C$  be a constant number, which, multiplied by the square of the number of degrees from  $T$ , shows the amount of loss for that number of degrees; let  $T \pm N$  be the temperature for which the rate ( $R^1$ ) is required; then  $R^1 = R + C \times N^2$ .  $C$  and  $T$  remain constant for long periods; "as a rule they do not change as long as the adjustments of the chronometer are not altered and the instrument remains in good condition."  $R$ , however, should be determined as often as possible.

I have given a somewhat detailed account of the results so far reached at the Liverpool observatory, as I had the benefit of personally inspecting the apparatus and the records, and as the subject appears to be a most important one. The formula used by Mr. Hartnup was, so far as I know, first employed practically by Professor G. P. Bond, of Harvard College observatory, and is given in the Coast-Survey Report for 1854, in connection with the discussion of the transatlantic longitude by the transport of 145 chronometers between Mr. Hartnup's observatory at Liverpool and the Harvard College observatory. In a second series of voyages in 1855 this formula was most carefully tried, and was proved to represent closely the effect of temperature upon the rates.

This subject is now receiving attention from various public establishments in Europe, and from the naval observatory.

The French have taken a leading position in this class of inquiries ever since the publication of Lieussou's "*Recherches sur les Variations de la Marche des Chronomètres*," (1853), and in the 10th *cahier* of the "*Recherches sur les Chronomètres*" papers, by de Magnac and Fleurais, lieutenants-de-vaisseau of the navy, seem already to have conducted to most promising results. The elaborate memoir of M. Yvon Villarceau, in the 7th volume of the "*Annales de l'Observatoire de Paris*," will long remain

as a foundation for all theoretical researches upon this subject. The *Dépôt de la Marine* at Paris and a branch establishment at Toulon are devoted to the practical carrying out of these objects. In Germany, the observatories of Kiel and Hamburg, and others, have instituted most important experiments, and in the testing of various formulæ many experiments have been made, both in Germany and France, which all go to prove that on the whole the preliminary testing of chronometers on shore by suitable appliances and by proper means not only serves to detect the badly-compensated chronometers, but also enables the navigator to predict from shore-observations at various temperatures what the rate of his chronometers will be at any given temperature, at least approximately. In order that this may be done successfully it is essential that the final rates should be obtained at the seaport, and the chronometers placed on the ship with as little disturbance from transportation as possible. If they can be rated without removing them from the navigator's room an important point is gained.

The chief theoretical difficulties to be overcome are the finding of some convenient and short method (probably graphical) of applying the formulæ and the determining the *limits* within which a predicted rate is to be relied upon.

That these difficulties are capable of being overcome appears most probable.

In the *purchase* of chronometers for the English navy (and for the French services also) a most admirable plan is adopted, which is worthy of attention. Any chronometer-maker is allowed to send to the Royal Observatory at Greenwich chronometers for an annual trial. These are severely tested at various temperatures and in various positions with respect to the magnetic meridian, (a most important precaution, since some chronometer-balances have acquired a polarity by long standing in one position, and their rate is thus made to depend upon their position with respect to the magnetic meridian,) and at the end of the period of test a certificate is given to the maker. The results are printed in detail and widely circulated, and the successful chronometers are recommended for purchase by the government. In this way a healthy competition is preserved among the makers, and the government is assured of possessing the best instruments.

In France, in addition to the above system, an annual prize of 1,200 francs is decreed to the successful maker.

#### IV.—CONTROLLED CLOCKS, TIME-SIGNALS, AND TIME-BALLS.

The importance of furnishing correct time to vessels lying in sea-ports, to chronometer-makers and others, has led me to collate from the materials at my disposal a few notes upon the systems now adopted in various places for these purposes.

It is as complete as the somewhat meagre returns will enable me to make it, but no doubt many places which are furnished with time-signals are omitted from the list. It is valuable as showing what efforts are now making by foreign and American observatories to attain the objects in view; and also in another respect, as the extent of the various systems will show at least approximately, the estimation in which the information supplied is held by the various communities. The admirable system pursued at Greenwich, for example, is peculiarly worthy of attention, as it is of gradual growth, and the result partly of the requirements of the various communities benefited, and partly of the enlightened views of the astronomer royal, who has from time to time proposed extensions, which have been found highly desirable. The great esti-

mation in which this and similar work is held among the communities who benefit by it is a sufficient proof of its usefulness. The peculiar advantages of a standard time will be, *in inland cities*, for the purpose of regulating the hours of business and work, the starting of railway-trains, etc. The time saved in the city of London alone, in the appointments of business men, must be enormous. In *sea-ports*, the uses to be subserved are much more important. As the chronometers of merchant-ships are usually rated by the nautical-instrument makers, who in most cases cannot themselves determine the time with proper accuracy, and who in few instances are sufficiently informed to make the best use of the imperfect instruments which they have, the giving to navigators an independent check upon them is a work of no small value, and the furnishing of time to the makers themselves a very great and positive benefit.

*List of time-balls, time-signals, &c.*

EUROPE.

**HELSINGFORS.**—A time-ball is dropped daily at noon at the observatory and a time-gun fired, either on the guard-ship or ashore.

**BERGEN.**—A time-ball is dropped daily at noon by the observatory.

**ST. PETERSBURG.**—Several public clocks in the city are controlled from the Pulkova observatory, and a time-ball (or time-gun) marks the instant of noon daily.

**DANTZIG.**—A time-ball is dropped at local mean noon, and one at Greenwich mean noon daily.

**KIEL.**—Time-ball (or time-gun) for shipping.

**HAMBURG.**—Time-ball (or time-gun) for shipping.

**PARIS.**—The public clocks are controlled from the observatory.

**CHERBOURG.**—A Paris mean noon is indicated by the dropping of a flat disc.

**LISBON.**—A time-ball is dropped from the observatory at 1<sup>h</sup> Lisbon mean time, and one is dropped simultaneously on the south side of the river from the Praya flag-staff.

**CADIZ.**—A time-ball is established at Cadiz, but I have no details regarding it.

**NEUCHÂTEL.**—An extensive system of electrically-controlled clocks and of time-signals radiates from this observatory, for the purpose of giving the true time to the chronometer-makers of the numerous factories, and for the general convenience of the public. The canton Vaud, adjoining the canton Neuchâtel, has asked for an extension of this system to some of its important towns.

**BERNE.**—I am informed that a system of time-signals is established here.

**TOULON.**—I am informed that standard time is provided for the use of navigators.

AFRICA.

**THE CAPE OF GOOD HOPE.**—There is a time-ball daily at 1<sup>h</sup> mean time.

**ALGOA BAY, (Port Elizabeth.)**—A time ball at 1<sup>h</sup> Cape of Good Hope mean time = 23<sup>h</sup> 46<sup>m</sup> 5<sup>s</sup> Greenwich mean time, is dropped daily.

ASIA, ETC.

**MADRAS.**—A time-ball is dropped daily from the custom-house at 8<sup>h</sup> 20<sup>m</sup> 57<sup>s</sup>.3 Madras civil time = 15<sup>h</sup> Greenwich mean time. The time of

the flash of the evening-gun is noted at the observatory, and published at the master-intendant's office the next day.

BATAVIA.—There is a time-ball dropped at Batavia mean noon, and also one at  $1^h 7^m 12^s.5$  Batavia civil time =  $18^h$  Greenwich time.

VLADIVOSTOK.—There is a branch of the Russian hydrographic office at this place, at which a naval officer obtains the time daily with a transit-instrument, and keeps a clock regulated for the use of navigators.

CALCUTTA.—There is a time-gun at this port.

## AUSTRALIA.

MELBOURNE.—A time-ball is dropped daily (Sundays excepted) at 1<sup>h</sup> mean time. The time is also given daily at  $8^h$  by the obscuration of a powerful light at two minutes before  $8^h$ ; the instant of re-appearance of the light is the true time. The errors of these two signals on any day are published on the next day in the newspapers.

ADELAIDE.—A time-signal is, I believe, established at this port.

SYDNEY.—The observatory drops a time-ball daily.

NEWCASTLE.—A time-ball is dropped by signals from Sydney.

## SOUTH AMERICA.

RIO DE JANEIRO.—I have no thoroughly satisfactory data, but I am informed that a ball is dropped daily.

BUENOS AYRES.—The observatory of Cordoba sends electric signals to Rosario and Buenos Ayres for the regulation of clocks which are accessible to ship-masters.

## NORTH AMERICA.

SAINT JOHNS, N. B.—There is a time-ball daily (except Sundays) at 1 o'clock. It is dropped by a chronometer, which is compared with a clock rated by a transit-instrument.

QUEBEC.—A time-ball is dropped for the shipping at  $1^h$ , and a time-gun fired in the city for public convenience at noon.

KINGSTON.—Time is given to the city and to the shipping daily from the observatory.

ONTARIO.—For the past four years the observatory has struck its time-signals on the fire-alarm bells of the city.

BOSTON.—For some years the Harvard College observatory has controlled clocks in Boston and furnished standard time to some of the railways.

ALBANY.—It is understood that the Dudley Observatory furnishes standard time to the city and to the Hudson River Railway.

PITTSBURG.—The city-hall clock is controlled from the Alleghany observatory, and the fire-alarm bells are struck at noon and every third hour. Time is furnished to the Pennsylvania Railway.

CINCINNATI.—The clock on the city-hall is controlled by electric signals from the observatory every two seconds, and the fire-alarm bells are struck at noon.

CHICAGO.—Time is given to the city from the observatory.

WASHINGTON.—A time-ball is dropped daily (Sundays excepted) at noon. Clocks in the city are controlled (on Jones's system) at the Navy, State, and Treasury Departments, at the Signal Office, and one is proposed for erection at the Western Union Telegraph Office. The city

fire alarm bells are struck daily (except Sundays) at 7 a.m., noon, and 6 p.m.

Daily, at noon, (excepting Sundays,) a signal is sent by the observatory (by hand, not automatically) to the Washington office of the Western Union Telegraph Office, and by them distributed over such of their wires as are unemployed. Practically, this signal reaches New York, Philadelphia, etc., nearly every week day, not more than six or seven failures to transmit to New York occurring in a year. Chicago, Cincinnati, etc., receive the signals more irregularly. San Francisco receives them only at long intervals. The signals are better distributed along the seaboard (north and south) than toward the west. The sending of this signal is not obligatory upon the telegraph company, as it is sent over their wires without compensation. In the central office in New York City, various clocks about the building are practically kept right by the signals from Washington, and time is furnished to a few chronometer-makers, etc.

**PHILADELPHIA.**—The Philadelphia Local Telegraph Company owns nearly all the lines in this city, and the manager of this company takes an intelligent interest in the question of public time. He has for some years supplied, at his own motion, the noon signal from Washington to various establishments in the city, and to many of the private telegraph-lines owned by merchants for the purposes of business.

### GREAT BRITAIN.

**LIVERPOOL.**—A time-ball is dropped daily at 1<sup>h</sup>, which is visible to the shipping; a time-gun is fired at the same hour from the Morpeth-dock pier-head, (automatically;) the public clock in the Victoria tower and various other public and private clocks are controlled by signals from the observatory.

**GLASGOW.**—The wire formerly owned by the observatory has been transferred to the government telegraphs, which distributes the time-signals to the public at very low rates; for example, a clock within one-third of a mile of the post-office will be controlled for £1 per year, etc.

**DUN-EGHT, (near Aberdeen.)**—Lord Lindsay's private observatory fires a time-gun daily for the public convenience.

**EDINBURG.**—A time-ball, visible to the shipping in the firth, is dropped from the top of Nelson's monument on the Calton Hill, a time-gun is fired (automatically) at the castle, and several clocks are electrically controlled, some of them being exposed for the convenience of the public. Time is sent daily to Dundee.

**DUNDEE.**—Signals are received daily from Greenwich and Edinburgh, and a time-gun is fired (automatically) at 1<sup>h</sup>, Greenwich mean time.

**DUBLIN.**—The Greenwich time-signal is received daily at 10 a. m., and distributed. I am not informed as to the details.

**BELFAST.**—The Greenwich signal is received at 10 a. m., and distributed.

**GUERNSEY.**—The Greenwich time-signal is received at 10 a. m.

**NEWCASTLE.**—Automatic time-gun at 1<sup>h</sup>, Greenwich time.

**SUNDERLAND.**—Automatic time-gun at Greenwich 1<sup>h</sup>.

**MIDDLESBOROUGH.**—Automatic time-gun at Greenwich 1<sup>h</sup>.

**KENDAL.**—Automatic time-gun at Greenwich 1<sup>h</sup>.

**DEAL.**—A time-ball is dropped at 1<sup>h</sup>, automatically, from Greenwich.

**START POINT AND PORTSMOUTH.**—Time-balls at 1<sup>h</sup> are proposed.

**NORWICH.**—Greenwich time is daily distributed.

**STOCKTON.**—Greenwich time is daily distributed.

WORCESTER.—Greenwich time is daily distributed.

NOTTINGHAM.—Greenwich time is daily distributed.

GREENWICH.—*Time-balls*.—A time-ball is dropped at the observatory at 1<sup>h</sup> daily, which is plainly visible to the shipping in the Thames. A time-ball is dropped (automatically) at Deal; it has been lately proposed to drop a time-ball at Portsmouth, and the astronomer-royal suggests that one should also be established at Start Point.

*Time signals*.—The current is sent hourly from Greenwich to the general post-office. This hourly current is transmitted to ten subscribers (mostly chronometer-makers) in London. The Westminster clock on the houses of Parliament, as well as the clock at the general post-office, records its errors at Greenwich electrically. The 10 a. m. current is sent *automatically* to 21 provincial towns in England, (where there are subscribers,) and to Guernsey, Edinburgh, Glasgow, Dublin, and Belfast. In addition to controlling the automatic sender, this current influences a sounder, and when this is heard, the signal is sent by hand to over 600 offices in direct communication with the central one. This includes the principal railway termini. Many of these 600 offices redistribute the time-signal at 10 a. m. to the branch offices radiating from them. The 1 p. m. current is transmitted *automatically* to Newcastle, Sunderland, Middlesborough, Kendal, Hull, Norwich, Stockton, Worcester, and Nottingham. At the first four, time-guns are fired; at the others, the current either drops a time-ball, or registers itself through a galvanometer. It should be noted that the signals, as sent, are the best determinations of time possible under the circumstances, and that the final correction to the sending-clock on any day is subsequently determined with great care. So much labor is expended upon the system that the astronomer royal considers that these hourly signals "may be used for accurate determinations of longitude."

No pains are spared in the carrying out of this admirable system, and the observatory is rewarded by the very high appreciation which its labors in this direction have commanded from ship masters and owners, from the railways, and from the general public.

It should be mentioned, in connection with the time-signal system of Great Britain, that the post-office department will undertake to construct and maintain a private wire, and to furnish the Greenwich time-signals to the private-houses, &c., of subscribers at very low rates, and this system is carried out quite extensively.

I permit myself to make a few remarks upon the various systems suggested by the above data, and by the information I was able to acquire in England, in so far as they apply to the United States.

#### CONTROLLED CLOCKS.

The system which has been found most satisfactory abroad contemplates the establishment of controlled seconds clocks, exposed in public places, so that from the clock-face there may at once be taken the *hour*, *minute*, and *second* of true time. Such clocks require a special wire, as, in order to be perfectly trustworthy, they should be controlled from the observatory clock by very frequent signals. It must be remembered that, in order to be valuable at all, they must be *thoroughly* trustworthy, and therefore, in this system, expensive.

It may be reasonably supposed that as fast as such clocks are really required by a community they will be applied for, either to some one of the numerous and well-equipped private observatories, or to the public observatory of the United States.



It would seem that this want may be trusted to make itself known in the future as it has in the past.

#### TIME-SIGNALS.

The distribution of time-signals (either with or without *controlled* clocks) to railways, etc., is a most important matter, in which the United States is far behind England, for example, where about 500 railway-stations receive a signal daily. This is partly due to the enormous extent of America in longitude, so that very different local times are used at different places of the same continuous railway-line, and partly to the fact that the telegraphs are owned by the government in England, thus rendering the execution of a general system of time-signals comparatively easy. In the opinion of many experienced and prominent railway officials, it is quite feasible and very desirable for all railways to be operated by one common time, and the first step toward this is plainly the *certainty* that the time-signals which are now regularly sent from the Naval observatory shall reach each railway-station once daily, at least. This would require contracts to be entered into with the various telegraph companies, binding them to the delivery of the signals, and probably this change, which would involve considerable expense, is not at present called for. If the want is made known, ample facilities exist at the Naval observatory, etc., for supplying it.

It should be remarked that this change, as well as the changes it would imply, and which would follow as natural consequences, is not by any means so violent as the change from the English system of measures—feet, pounds, bushels, etc.—to the metric system—metres, grammes, litres, etc.—often proposed and now partially adopted. In the latter case the *units* are altered, and for the first generation, at least, continual reference will have to be made from the old system to the new; whereas in the first case the units remain the same, and the point of reference only is changed. Once familiarize a citizen of Detroit with the fact that his local mean noon is to be called 12<sup>h</sup> 24<sup>m</sup>, and the transition would hardly be noticed.

It has been said that the various cities, towns, etc., could be trusted to ask for such facilities in the way of standard time as they required, and that the numerous private observatories or the Naval Observatory could easily supply any want. The necessity for time-signals, time-balls, or time-guns for the benefit of navigators would be, on the other hand, a want long felt before any official and formal request for their establishment would be made.

A time-gun, if established in New York Harbor for example, would be used by a great number of vessels, which would be saved thereby the necessity of sending their chronometers to the city for rating, and thus exposing the instruments unnecessarily to the danger of a change of rate in the transportation back to the ships.

A time-gun at Hampton Roads would be used by all vessels proceeding on long voyages from Baltimore, the Potomac, and Richmond, and by the large number of ships calling at Hampton Roads for orders there to carry their cargoes. It would be particularly valuable to ships using this roadstead as a harbor of refuge on their voyages, which ships at present seldom or never wait for fair weather to rate their chronometers, but on the first appearance of settled weather slip out to sea to continue their voyages.

The absence of such time-signals has not given rise to formal requests for them, simply because the masters of ships entering any port are con-

stantly changing, and because, from the nature of their profession, little or no concerted action can be expected from them. It would be plainly an advantage not only to merchant vessels, but to ships of war, if the two signals above named could be established. If this could be *economically* done it might be considered advisable. In the case of vessels of the Navy, few are now fitted out and sail from the Washington yard. They therefore receive their chronometers from the Naval Observatory after a longer or shorter railway journey. The rates of the chronometers are thus altered by this unavoidable cause, and the advantages to the Navy which should result from the careful comparisons and tests of chronometers now made at the Naval Observatory are somewhat lessened. In order that the greatest benefit to the Navy should result from the trials of chronometers at the Naval Observatory, it is necessary that the standard time which is there daily determined should be available to navigating officers at the various ports, to aid them in getting the final rates for their chronometers before sailing. Although the navigators should also, in all cases where it is possible, rate their chronometers by their own observations, yet this is a process requiring time, and one which circumstances may render impracticable.

To do it properly, observations are required on two dates *at least* five days apart. This may not be practicable: *first*, because this entire time may be cloudy, and *second*, because the ship may be required to go to sea in the meanwhile. During a war the difficulty would be increased. A very simple and economical way has lately been suggested, by which these wants could be filled satisfactorily and cheaply. It provides:

1st. That each navy-yard on the Atlantic coast, or so many of them as it may be desirable to include in the system, should connect the office of its navigation-officer with the nearest telegraph office. This could be done at a cost of about \$80 a mile, and the annual cost of maintenance is trifling. The total first cost for each navy-yard could hardly be more than \$100.

2d. The noon-signal from the Naval Observatory, Washington, should be received daily by the navigation-officer at each yard by his chronometer. Its error on Washington time would thus be known, and its rate.

3d. At 0<sup>h</sup> 51<sup>m</sup> 47<sup>s</sup>. 88, Washington mean time = 6<sup>h</sup> Greenwich time. a time-gun should be fired at the navy-yard by a simple electric current. If desired, a time-ball could be substituted for the gun. The annual expense of maintaining either of these would be very small, and the first cost of the ball trifling. The guns are already at hand.

By the method here proposed, which requires the signal to be made by a local battery at the yard, and not by a current from Washington, the difficulties of performing this latter operation automatically by telegraph from Washington are avoided, the expense is greatly reduced, the cost of the necessary apparatus is lessened, and the services of highly intelligent officers are enlisted, most of whom are familiar with the simple electric apparatus employed, from their previous experience at the Newport torpedo-station.

It should be understood that any error in giving the time signal should be noted in the daily papers.

4th. To the carrying out of the above programme it is *essential* that the time signals from Washington should be transmitted daily, without the least chance of failure or interruption. A service of this sort must be absolutely unbroken, and must be executed with the most scrupulous accuracy, or it is worse than useless.

In order to this, a contract would have to be made with the telegraph

companies, binding them to transmit the noon-signal from Washington. The cost of this will be about as below :

	Yearly.
For the Norfolk yard.....	\$313 00
For the New York yard.....	313 00
For the Philadelphia yard.....	313 00
For the Boston yard.....	626 00
For the Portsmouth yard.....	939 00

The entire cost of the experiment for one year at the New York and Norfolk navy-yards will be about \$800. It is submitted that the Navy will receive the immediate benefit of this, and that incidentally, and at a trifling expense, much good can be done for vessels of the merchant service.

#### V.—THE BATHOMETER OF DR. C. W. SIEMENS, F. R. S., ETC.

The best description of this instrument is to be found in *Nature* for March 30, 1876, from which the following account is taken :

#### ON DETERMINING THE DEPTH OF THE SEA WITHOUT THE USE OF THE SOUNDING-LINE.

This is the title of a paper which has been presented to the Royal Society, and Mr. Siemens gave, at the meeting of the 24th ultimo, a description of the instrument which he has designed with this object. He commenced by giving a mathematical statement of the effect of local attraction, to a certain depth, on a body placed at the surface of the earth, assuming it to be of uniform density, spherical in form, and unaffected by centrifugal action. For small values of depth ( $h$ ) this attraction is  $2\pi k$ . The original formula from which this is deduced is :

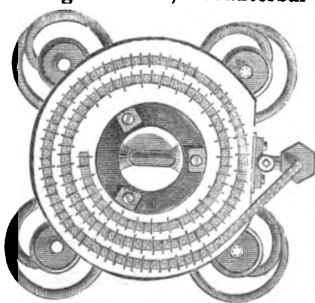
$$2 \pi k \left( 1 - \frac{2}{3} \sqrt{\frac{h}{2R}} \right),$$

and by substitution of  $2R$  for  $h$  in this, Newton's statement of the total attraction  $\frac{4}{3} R \pi$  is obtained.

Now, if in place of the solid substance which forms the exterior crust of the earth, whose density may be taken to be the mean density of superficial rock, water, a material of less density, is substituted, it is shown that the total attraction must be diminished, and the measure of this diminution is a measure of the depth of light substance which has been substituted for heavy. If we were in possession of the exact mean density of the earth, of that of the surface-rock, and of sea-water, a scale could be calculated beforehand to show what depth would agree with a certain diminution of the measured effect of gravitation. Such an approximate calculation was made in designing the instrument, but Mr. Siemens has preferred to compare the readings of the instrument with actual soundings, in order to obtain a scale.

The instrument, which is called a bathometer, consists of the following parts: a weight, being a column of mercury affected by variation of gravitation, a counterbalance, being springs unaffected by variation of gravitation, and an arrangement by which the variations in gravitation can be read as depth in units. The column of mercury is maintained in a vertical steel tube having cup-like extensions, the lower portion being closed by a corrugated diaphragm of thin steel plate, and the upper portion containing an aperture or filling the instrument, having a screw stopper. The internal diameter of the tube is reduced at the upper portion, in order that the vertical oscillations of the mercury produced by the motion of a vessel in a sea-way may be reduced to a minimum, and the instrument is suspended in a universal joint above its center of gravity, so that it may always hang in vertical position at sea, and is inclosed in an air-tight casing, so that it may not be under the influence of atmospheric changes. The weight of the column of mercury is balanced at the center of the diaphragm by the elasticity of the steel springs, and the *modus operandi* of the instrument is evident; as the mercury diminishes in potential through the effects of diminished attraction, the action on the springs diminishes, and these shorten upon themselves.

There are some peculiarities in the mechanical arrangement of the instrument which pay examination. Both ends being open to the air, its indications are not affected by variations of atmospheric pressure. With regard to temperature, the instrument is *parathermal*.



The description, etc., in the Catalogue of the South Kensington Exhibition, (2d edition, page 85,) should also be consulted.

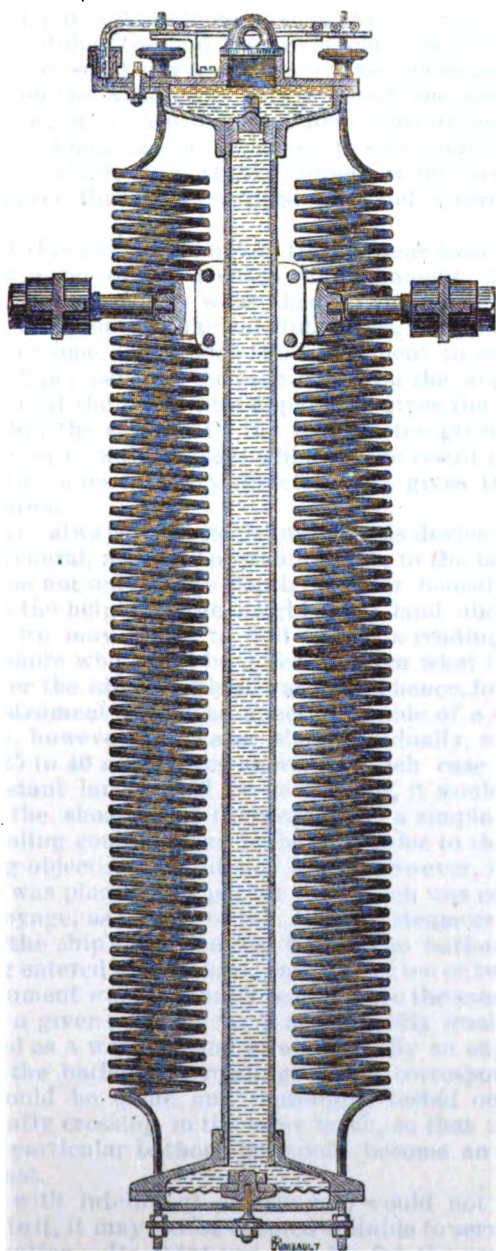
By the courtesy of Dr. Siemens I was enabled to see the manuscript account of soundings taken with this instrument on board the Faraday in October and November, 1875, and in March and April, 1876. During her voyage across the Atlantic at that time frequent soundings were made with the piano-wire sounding apparatus of Sir William Thompson, and at each one of these soundings the bathometer was read by Dr. Hicks, who had it under his charge. The results are exhibited in the following table:

A.	B.	A-B.	(A-B) ÷ B.
Bathometer.	Piano-wire.	Error of bathometer.	
<i>Fathoms.</i>	<i>Fathoms.</i>	<i>Fathoms.</i>	<i>Per cent.</i>
201	197	+ 4	+0.020
99	100	- 1	-.010
63	54	+ 9	+.185
82	82	0	.000
218	214	+ 4	+.019
78	69	+ 9	+.130
56	54	+ 2	+.037
55	54	+ 1	+.017
20	56	- 6	-.107
47	54	- 7	-.130
50	58	- 8	-.138
66	69	- 3	-.043
82	73	+ 9	+.122
56	47	+ 9	+.171
49	46	+ 3	+.065
80	69	+ 11	+.160
111	100	+ 11	+.110
215	200	+ 15	+.075
69	64	+ 5	+.078
80	80	0	.000
86	86	0	.000
68	76	- 8	-.105
388	353	+ 35	+.099
799	698	+ 101	+.143
607	503	+ 104	+.206
2,789	2,516	+ 273	+.108
2,388	2,320	+ 68	+.029
1,907	1,861	+ 46	+.025
1,615	1,700	- 85	-.050
Mean.....			0.083

The following soundings were taken in March and April, 1876, by Alexander Siemens, esq., near Nova Scotia. Some sources of error had in the meanwhile been removed:

A.	B.	A-B.	(A-B) ÷ B.
90	90	0	0.000
94	92	+ 2	+.022
95	94	+ 1	+.011
107	101	+ 6	+.059
105	105	0	.000
64	64	0	.000
64	61	+ 3	+.049
56	53	+ 3	+.057
66	68	- 2	-.030
29	27	+ 2	+.074
43	38	+ 5	+.132
Mean.....			0.039

It will be seen from the table that the mean error is a little over 5 per cent. for the first trials, during which time the instrument (which





was the first of its kind) was subject to various sources of error, some of which have now been removed by better mechanical arrangements, and a few of which remain to be overcome. It will also be observed from the second part of the table that in April, 1876, after certain of these mechanical difficulties had been overcome, the percentage of error was much reduced, so that a sounding by the instrument and one by the line agreed on the average to within about *four per cent.* Dr. Siemens is now engaged in incorporating some improvements into a new instrument of this kind, and in particular in substituting for the corrugated diaphragm, which supports the column of mercury, one made of steel which is sawed through in a spiral form and covered by a sheet of india rubber.

In the trial of this first bathometer, Dr. Siemens took it to the top of the great clock-tower of the Houses of Parliament, (315 feet) and it was found to read very closely what theory demanded. It may be reasonably hoped that the mechanical difficulties, which are very great, can be so far overcome as to cause the instrument to read in the open sea within 1 or 2 per cent. of the true depth on the average. It must be remembered that the piano-wire apparatus gives the depth of water immediately below the ship, while the bathometer gives an indication of an attraction (or of a deficiency) which is the result of the depth of water for several miles in every direction. It gives the mean depth over a certain area.

A difficulty will always arise in the use of this device as a *navigating* instrument in general, as, on approaching close to the land, it will give an indication due not only to the depth of water beneath the ship, but partially due to the height of the neighboring land above the level of the sea. Thus we may expect to find *always* a reading of the instrument near the shore which will be different from what it would give in the open sea over the same depth of water, and hence, for general cruising, such an instrument will be an uncertain guide of a close approach to land. When, however, the water shoals gradually, so that the 100-fathom line is 25 to 40 miles from shore, in which case the disturbing effect of the distant land would be very small, it would indicate with great certainty the shoaling of the water, and a simple observation of the *rate* of shoaling could not fail to be of service to the navigator.

The foregoing objections would not apply, however, in a case where the instrument was placed on a packet-ship which was continually making the same voyage, as on one of the Atlantic steamers for example.

If whenever the ship's position was known the bathometer was read and the reading entered on the chart, and if after ten or twenty voyages a particular instrument was constantly seen to have the same reading when the ship was in a given position, (as it undoubtedly would,) it could not fail to be trusted as a warning and as an aid. By an experience of this kind a table of the bathometer-readings which corresponded to particular positions could be made and thoroughly tested on such a vessel, which is constantly crossing in the same track, so that after a time the reading of this particular bathometer would become an important sign of nearing a coast.

In this way, with intelligent officers who would not fail to put the necessary tests to it, it may yet be deemed suitable to serve as an important aid to navigation. Its great use will be, for the present, on board of special surveying ships, to indicate not so much the actual and absolute depths as the *changes of depth*. If, for example, a ship is engaged in making soundings with a trustworthy apparatus on board, and if it is found that a given depth by the piano-wire always corresponds very nearly to

the same reading of the instrument, (as it would,) and if this continues to be so, then a change in the reading of the bathometer would indicate to the commanding officer the passage over shoaler or deeper water, as the case might be, and it would show the necessity for a new sounding, a necessity which otherwise would be overlooked. In the hands of intelligent officers this instrument, which is now an experiment merely, may become of great value, and it is quite within reasonable expectations to hope for valuable aid from it in its perfected form.

It is understood that an instrument of this class will soon be in the possession of the Navy Department, and one has been proposed for use on H. B. M. S. Fawn, and upon the reports of the officers who have it in charge further opinions must be based.

In concluding this report, I desire to express my sense of its incompleteness, which is partially due, however, to the impossibility of presenting a large portion of my notes without a series of drawings and plans. I trust that some idea of the importance of the loan collection may be obtained from it, and of the great credit due to its originators, and to those who carried out the design in so thorough a manner.

I have the honor to be, sir,

Very respectfully,

Your obedient servant,

EDWARD S. HOLDEN,

*Professor, U. S. Navy.*

U. S. NAVAL OBSERVATORY, October 31, 1876.

A.—*Science and art department of the committee of council on education, South Kensington.*

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#### ARRANGEMENT OF THE EXHIBITION.

The exhibition will consist of instruments and apparatus employed for research, and other scientific purposes, and for teaching. It will also include apparatus illustrative of the progress of science, and its application to the arts, as well as such as may possess special interest on account of the persons by whom, or the investigations in which, it had been employed. The precise limits will be found further detailed under the several sections in which the various objects have been arranged for convenience, and for the information of exhibitors, rather than as a matter of scientific classification. Models, drawings, or photographs will also be admissible where the originals cannot be sent.

The apparatus may, in certain cases, be arranged in train as used for typical investigations. And arrangements will be made, as far as it may be found practicable, for systematically explaining and illustrating the use of the apparatus in the various sections.

While every care is taken of objects lent for exhibition, the science and art department cannot be responsible for loss or damage.

The committees will have the right of rejecting any object that it may be thought inadvisable to exhibit.

The cost of carriage of all objects selected for exhibition will be defrayed by the science and art department.

It is hoped that institutions or individuals having instruments of historic interest will be good enough to lend them.

Forms on which to enter descriptions of objects offered for exhibition may be obtained on application to the director of the South Kensington Museum, London, S. W. These forms should be filled up and returned as soon as possible, so that exhibitors may receive early intimation as to the admissibility of the objects they propose to send.

The exhibition will open on the 1st April, 1876, and will remain open until the end of September, after which time the objects will be returned to the owners.

#### ARITHMETIC.

Apparatus for teaching arithmetic; calculating-machines; instruments for solving equations; slide rules—numbering and enumerating apparatus, &c.



## GEOMETRY.

Instruments used in geometrical drawing; methods of copying; pantagraph, micrograph; Peaucellier's cell and parallel motion; machines for description of curves and specimens of the curves they describe, including geometric turning; instruments for giving graphic representations of phenomena; models to illustrate descriptive geometry; specimens to illustrate the process of making models according to a design; models to illustrate solid geometry, perspective, crystallography, &c.; stereoscopic illustrations of solid geometry.

## MEASUREMENT.

*Of length.*—Standard yard, meter, &c.; comparator for standards of length, (sight and touch; ) gauges, measuring-wheels, steel tapes, &c.; micrometers and verniers; cathetometers.

*Of area.*—Planimeters, &c.

*Of volume.*—Standard gallon, liter, &c.; pipettes, burettes. Meters for gas, water, &c.

*Of angles.*—Divided circles, theodolites, clinometers, goniometers, &c.

*Of mass.*—Standard pound, kilogramme, &c.; vacuum and other balances.

*Of density.*—Specific-gravity bottles, areometers, &c.

*Of time.*—Clocks and pendulums, chronometers, watches, and balance-wheels; tuning-forks for measuring small intervals of time; chronographs.

*Of velocity.*—Such as Morin's machine; strophometers, current meters, ships' logs, &c.

*Of momentum.*—Ballistic apparatus.

*Of force.*—Spring balances, pressure gauges, torsion balances, &c.

*Of work.*—Indicators, dynamometers, &c.

## KINEMATICS, STATICS, AND DYNAMICS.

Elementary illustration; position and displacement of a point, a rigid body, or a material system; composition and resolution of displacements; velocity and acceleration, their composition and resolution; displacements of a connected system; principles of mechanism; rolling contact, sliding contact, belting, link connections, shafting, universal joints, &c.; transmission of work; relation between the displacement of two pieces of a machine and the forces which they transmit; the mechanical powers; instruments for illustrating the laws of motion, such as pendulums, gyroscopes, dynamical tops.

Laws of fluid pressure; stability of floating bodies.

Discharge of fluids through orifices, and their motion in channels.

Hydraulic and pneumatic transmission of power.

## MOLECULAR PHYSICS.

Instruments and apparatus employed in teaching, and in the investigations and observations connected with:

*Pressure on matter.*—Tension, compression, (piezometer,) torsion, flexion; relation of volume to pressure; elasticity of liquids and gases; hardness, (of solids and liquids,) toughness, brittleness, malleability, &c.

*Communication of pressure through fluids.*—Pressure of air, its consequences and applications; barometers, air-pumps, siphons, suction-pumps, spirators, &c.; pressure of water, its consequences and applications; levels, side pressure, &c.

*Density.*—Methods of measuring densities of gases, vapors, liquids, solids.

*Adhesion and cohesion.*—Condensation of gases in solids, solution of gases in liquids; mixing of gases with gases, (diffusion, transpiration, &c.,) absorption of liquids by solids, (capillarity, &c.,) absorption of liquids by gases, (evaporation, &c.,) mixing of liquids with liquids, (osmose, diffusion dialysis.) Evaporation of solids, solution of solids, mixture of solids with solids, (cementation, &c.)

## SOUND.

Instruments and apparatus employed in teaching, and in the investigations and observations connected with:

*Geometrical, mechanical, and optical methods of illustrating the laws of wave-motion.*—Progressive waves, composition of vibrations, interference, stationary waves.

*Generation of sound.*—Fog-horn, &c.

*Conduction of sound.*—Through solids, liquids, and gases, stethoscopes.

*Velocity of sound.*

*Detection of sound.*—Sensitive flame, &c.

*Reflection and refraction.*—Ear-trumpets, acoustic lenses, &c.

*Dispersion and absorption.*

*Musical sounds.*—Pitch, standards of pitch, standard tuning-forks, &c.; methods of measuring and comparing rates of vibration; toothed wheels, syrens, &c.; vibration microscopes, &c.; methods of illustrating the nature of musical intervals; manometric flames, mirrored tuning-forks, &c.

*Musical quality.*—Illustrations of the different quality of the sounds of various instruments, harmonica, and overtones, resultant tones, instruments for studying quality Resonators, phonautographs, &c.

*Musical instruments illustrating the above.*—Methods of exhibiting the mode of vibration of various instruments and the quality of the sounds yielded by them.

#### LIGHT.

Instruments and apparatus employed in teaching, and in the investigations and observations connected with:

*Production.*—Combustion, electric discharge, &c.

*Measurement of intensity, velocity,*

*Action of matter on light.*—Reflection, refraction, dispersion, achromatism, direct vision prisms, polarization, absorption, (color,) fluorescence, &c.

*Action of light on light.*—Interference, diffraction, measurement of wave length, (optical banks,) &c.

*Action of light on matter.*—Photography, radiometry, phosphorescence, &c.

*Technical applications of optical principles.*—Light-house, illumination, &c.

#### HEAT.

Instruments and apparatus employed in teaching, and in the investigations and observations connected with:

*Sources of heat.*—Chemical, electrical, dynamical, solar, calorescence, &c.

*Effects of heat on matter.*—Changes of temperature, expansion, and change of elasticity, liquefaction, vaporization, &c.

*Measurement of temperature.*—Thermometers, pyrometers, &c.

*Propagation of heat.*—Radiant heat—radiometer, reflection, refraction, radiation. absorption, polarization; conduction—solids, liquids, gases; convection—ventilation, &c.

*Effect of change of molecular state on temperature.*—Freezing-mixtures, ice-machines, &c.

*Effect of change of pressure and volume.*

*Heat quantity.*—Unit of heat, calorimeters, specific heat, &c. Methods of determining latent heat.

*Mechanical equivalent of heat.*—Methods of determining. Illustrations of thermodynamics.

*Electrical equivalent of heat.*—Methods of determining.

*Analysis of solar radiation.*

#### MAGNETISM.

Instruments and apparatus employed in teaching, and in the investigations and observations connected with:

*Natural magnets.*

*Permanent artificial magnets.*

*Electro-magnets.*

*Methods of magnetization.*—Effects of magnetization. Conditions affecting intensity of magnetization: Temperature, (chemical,) composition, strains, &c.

*Magnetic induction of all substances.*—Diamagnetism.

*Measurement of intensity of magnetization, magnetic moment.*

*Terrestrial magnetism.*—Instruments for observation and automatic registration of the magnetic elements.

#### ELECTRICITY.

Instruments and apparatus employed in teaching, and in the investigations and observations connected with:

*Production and maintenance of difference of potential.*—Electrical machines acting by friction, induction, (doublers, replenishers, &c., Holz's and Töppler's machines, &c.; galvanic batteries; thermo-electric piles; magneto-electric machines. Other sources, such as pyro-electricity, pressure electricity, cleavage, capillarity, osmose, &c.

*Detection and measurement of difference of potential.*—Electroscopes, electrometers, standards of electro-motive force, methods of comparison.

*Accumulation of electricity.*—Insulators, condensers, accumulators, effects due to accumulated electricity, distribution on conductors, polarization of dielectrics, &c.

*Measurement of electric quantity.*—Torsion balances, standard accumulators, methods of comparing electric capacities and dielectric co-efficients.

*Detection and measurement of electric currents.*—Galvanoscopes, galvanometers, voltmeters, electro-dynamometers, &c.

*Resistance.*—Standards of resistance, methods of comparing resistances, methods of establishing absolute standards, (British Association unit apparatus.)

*Effects of electric currents.*—Production of light, heat, electrolysis, electro-diffusion. Action on magnets, soft iron, (electro-magnets,) action of currents on currents.

*Technical application of electricity.*—Electric telegraph, &c.

## ASTRONOMY.

star-maps, catalogues, globes, orreries, &c.	Micrometers.
meridian instruments.	Driving-clocks.
arrangements for communicating true time.	Special arrangements for—
altazimuths, zenith-sectors, sextants, &c.	Celestial photography.
quatorial telescopes, { Reflectors.	Spectroscopic observations.
{ Refractors.	Thermo-electric observations.
	Siderostats.

## APPLIED MECHANICS.

As the exhibition must be regarded as chiefly referring to education, research, and her scientific purposes, it must in this division consist principally of models, diagrams, mechanical drawings, and small machines, illustrative of the principles and progress of mechanical science, and of the application of mechanics to the arts.

properties of materials.	The application of the principles of mechanics to machinery as used in the arts. Shipping, naval architecture, and marine engineering.
structures at rest and in motion.	
time movers.	
reservoirs of energy.	
regulators.	

## CHEMISTRY.

Scientific instruments, apparatus, and materials employed in the investigation and teaching of chemical science, and in the application of its principles to scientific purposes.

diagrams and models.	Apparatus for distillation and filtration.
illustrations of analytical results.	Apparatus for operations by the dry or
specimens of chemicals—(a) organic, (b) mineral.	hot method, such as furnace, blow-pipe, &c.
apparatus and fittings for laboratory and lectures.	Refrigeratory apparatus.
apparatus for gravimetric and volumetric operations.	Apparatus for spectrum analysis.

NOTE.—Operations of the following nature may be illustrated, viz :

organic analysis.	Gas analysis.
mineral analysis.	Spectrum analysis.
electrolysis.	Methods of investigation connected with
water analysis.	vegetation and respiration.

## METEOROLOGY.

thermometers and barometers, of special construction.	Illustrations of various systems of storm-signals.
thermometers, rain-gauges, hydrometers, &c.	Weather-maps.
self-recording meteorological apparatus.	Instruments illustrating the phenomena of atmospheric electricity.
	Instrument-stands.

## GEOGRAPHY.

Instruments used in surveying.  
Instruments used in geodesy and hydrography, including hypsometrical instruments, level-gauges, &c.  
Projections, maps, charts, models, and globes.  
Deep-sea sounding apparatus. Seismographical instruments.

## GEOLOGY AND MINING.

Instruments for field and underground surveying,  
Typical collections of rock-specimens, including vein-stones.  
Typical fossils arranged stratigraphically.  
Maps in different stages, and finished maps.  
Geological models, horizontal and vertical sections.  
Diagrams and plates of fossils, and general geological diagrams used in lectures.  
Microscopic sections of rocks and minerals, and apparatus for cutting such sections.  
Barometers, water-gauges, mining-barometers, and thermometers.  
Mining plans, sections and models of workings.

## MINERALOGY, CRYSTALLOGRAPHY, &amp;C.

Goniometers.

Apparatus for studying and exhibiting the optical characters of crystals.

Sections for optical examination.

Blow-pipe and other portable apparatus for determining minerals.

Collections of crystals, models of crystals, plates of crystals, and apparatus for drying them.

Educational collections of minerals, &c.

Diagrams and models for lecture-rooms,

## BIOLOGY.

1. Microscopes with accessory apparatus for biological research, &c.

2. Physiological apparatus for investigating—

a. The growth and mechanical movements of living organisms and their parts

b. The chemical phenomena of living organisms.

c. The electrical phenomena of living organisms.

d. The functions of the nervous and other systems.

3. Apparatus for anatomical research.

4. Apparatus for collecting and preserving objects of natural history.

5. Appliances for teaching biology.

A limited number of examples illustrating the performances of the apparatus will be admissible.

*Science and art department of the committee of council on education—Loan collection of scientific apparatus, South Kensington Museum—Apparatus in action, explanations, &c.*

## PROGRAMME FOR THE WEEK ENDING SATURDAY, JULY 8, 1876.

## EVERY DAY.

10 a. m. to 1 p. m. ; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machines at work, room F; Pictet's ice-making machine at work in engine-house, room F.

## MONDAY.

12 noon.—Fajja's motometer, room H.

3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H; musical instruments, room Q.

4 p. m.—Bosanquet's enharmonic harmonium, room Q; Holmes's fog-horns, room E; Zanni's telegraphic apparatus, room F.

5 p. m.—Warden, Clarke and Muirhead's electric apparatus, room F.

7.30 p. m.—Post-office telegraphic apparatus, room F.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by the Right Hon. Lyon Playfair, C. B., M. P., F. R. S., on "Air and air, as illustrated by the Magdeburg hemispheres and Black's and Cavendish's balances."

## TUESDAY.

11 a. m. to 4 p. m.—M. Wiesnegg's furnaces, &c., laboratory adjoining room G.

2.30 p. m.—Lowne's ventilation anemometer, (Dr. Mann,) room G.

3 p. m.—Spectrum of electric light, room F; Stanley's pantographs, room G.

4 p. m.—Mr. Bonomi's apparatus for the identification of men, room M.

5 p. m.—Instruments lent by meteorological office explained, room L.

6.30 p. m.—Mr. Etler's electric machine, conference room.

7 p. m.—Tisley and Spiller's pendulum-apparatus, room H.

7.30 p. m.—Post-office telegraphic apparatus, room F.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

## WEDNESDAY.

11 a. m. to 4 p. m.—M. Wiesnegg's furnaces, &c., laboratory adjoining room G.

3 p. m.—Magnetic observatory outside room K; Poole's chronometers, room K.

5 p. m.—Shand and Mason's fire-engine models, room C.

## THURSDAY.

3 p. m.—Major Ross's blow-pipe apparatus.

4 p. m.—Holmes's fog-horns, room E.

## FRIDAY.

11 a. m.—Tisley and Spiller's pendulum-apparatus, room H.

4 p. m.—Mr. Skertchley's evaporimeter, room L.

## SATURDAY.

- 2 p. m.—Edmund Wheeler's microscopes, &c., room N.  
 2.30 p. m.—Mr. Laslett's microscope, room L.  
 3.30 p. m.—Mr. W. Groves's chronograph, room K.  
 4 p. m.—Instruments used by geographical travelers, room L.  
 4.30 p. m.—Mr. Perigal's kinematic models, room H.  
 5.30 p. m.—Siemens's bathometer and attraction meter, room H.  
 8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.  
 8 p. m.—Lecture by Dr. Gladstone on "The work of Davy and Faraday, as illustrated by the apparatus lent by the Royal Institution."

## PROGRAMME FOR THE WEEK ENDING SATURDAY JULY 15, 1876.

## EVERY DAY.

- 10 a. m. to 1 p. m.; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machines at work, room F; Pictet's ice-making machine at work in engine-house, room F.

## MONDAY.

- 10 a. m.—Lecture to science-teachers in science-schools, lecture-theater.  
 3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H.; Musical instruments, room Q.  
 4 p. m.—Bosanquet's enharmonic harmonium, room Q; Holmes's fog-horns, room E; Lecture to science-teachers, by Mr. Merrifield, F. R. S., "Measurements, linear and surface," in the lecture-theater, South Kensington Museum.  
 5 p. m.—Instruments lent by meteorological office explained, room L.  
 7.30 p. m.—Post-office telegraphic apparatus, room F.  
 8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.  
 8 p. m.—Lecture by the Rev. R. Main, M. A., F. R. S., on "The instrumental foundations of practical astronomy," conference-room.

## TUESDAY.

- 10 a. m.—Lecture to science-teachers, by Mr. W. Spottiswoode, F. R. S., on "Optical instrument employed in the polarization of light."  
 3 p. m.—Spectrum of electric light, room F; Lient. Gen. W. Smith's point-finder, room G.  
 4 p. m.—Lecture to science-teachers, by Mr. Merrifield, F. R. S., on "Measurements, linear and surface," Sugg's photometer, landing of south staircase.  
 6.30 p. m.—Mr. Etler's electric machine, conference-room.  
 7 p. m.—Tisley and Spiller's pendulum-apparatus, room H.  
 8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.  
 8 p. m.—Lecture by Prof. Francis Guthrie, "Heat and work," conference-room.

## WEDNESDAY.

- 10 a. m.—Lecture to science-teachers, by Professor Roscoe, F. R. S., "Technical chemistry," lecture-theater, science-schools.  
 2.30 p. m.—George's ventilating stove, (Doctor Mann,) laboratory adjoining room G.  
 3 p. m.—Magnetic observatory, outside room K.  
 4 p. m.—Lecture to science-teachers, by J. Norman Lockyer, F. R. S., "Spectroscopes," lecture-theater, South Kensington Museum.

## THURSDAY.

- 10 a. m.—Lecture to science-teachers, by Professor Roscoe, B. A., F. R. S., "Technical chemistry," lecture-theater, science-schools.  
 3 p. m.—Major Ross's blowpipe apparatus, laboratory adjoining room G.  
 4 p. m.—Holmes's fog-horns, room E; lecture to science-teachers, by J. Norman Lockyer, F. R. S., "Spectroscopes," lecture-theater, South Kensington Museum.

## FRIDAY.

- 10 a. m.—Lecture to science-teachers, by Professor Stokes, F. R. S., on "Fluorescence," lecture-theater, science-schools.  
 11 a. m.—Tisley and Spiller's pendulum apparatus, room H.  
 4 p. m.—Lecture to science-teachers, by Prof. E. Ray Lankester, on "Microscopic investigation," conference-room.

## SATURDAY.

- 2.30 p. m.—Mr. Laslett's microscope, room L.  
 4 p. m.—Admiralty charts, room M.  
 5.30 p. m.—Siemens' bathometer and attraction meter, room H.

8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.  
 8 p. m.—Lecture by Dr. W. H. Stone, on "Modes of eliciting and re-enforcing sound," conference-room.

## PROGRAMME FOR THE WEEK ENDING SATURDAY JULY 22, 1876.

## EVERY DAY.

10 a. m. to 1 p. m.; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machine at work, room F; Pictet's ice-making machine at work in engine-house, room F.

## MONDAY.

10 a. m.—Lecture to science-teachers, by Captain Abney, R. E., F. R. S., on "Photography," lecture-theater, South Kensington Museum.

12 noon.—Barlow's patent motometer, (Mr. Faija,) room H.

3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H; musical instruments, room Q.

4 p. m.—Bosanquet's enharmonic harmonium, room Q; Holmes's fog-horns, room E; lecture to science-teachers, by Mr. H. Dent Gardner, on "Time Measures," lecture-theater, science-schools.

5 p. m.—Aveling and Porter's road-locomotive, room C.

7.30 p. m.—Post-office telegraph-apparatus, room F.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Mr. C. V. Walker, F. R. S., on "Galvanic Time Signals," conference-room.

## TUESDAY.

10 a. m.—Lecture to science-teachers by Captain Abney, R. E., F. R. S., on "Photography," lecture-theater, South Kensington Museum.

2.30 p. m.—George's ventilating-stove, laboratory adjoining room G.

3 p. m.—Spectrum of electric-light, room F.

4 p. m.—Lecture to science-teachers, by Mr. H. Dent Gardner, on "Time Measures," lecture-theater, science-schools; Sugg's photometer, landing of south staircase.

6.30 p. m.—Mr. Etler's electric-machine, conference-room.

7 p. m.—Tisley and Spiller's pendulum apparatus, room H.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by the right honorable the Earl of Rosse, F. R. S., on "The Construction of Reflecting Telescopes and their relative advantages as compared with Refractors," conference-room.

## WEDNESDAY.

10 a. m.—Lecture to science-teachers, by Professor Williamson, Ph. D., F. R. S., on "Metallurgical Processes," conference-room.

3 p. m.—Magnetic-observatory, outside room K.

4 p. m.—Lecture to science-teachers, by Mr. A. B. Kempe, on "Link Motions," conference-room.

## THURSDAY.

10 a. m.—Lecture to science-teachers, by Professor Williamson, Ph. D., F. R. S., on "Metallurgical Processes," conference-room.

3 p. m.—Major Ross's blowpipe apparatus, laboratory adjoining room G.

4 p. m.—Holmes's fog-horns, room E; lecture to science-teachers by Prof. T. F. Pigot, on "Geometrical and Engineering Drawing," conference-room.

## FRIDAY.

10 a. m.—Lecture to science-teachers, by Prof. G. Carey Foster, B. A., F. R. S., on "Electric Measurements," conference-room.

11 a. m.—Tisley and Spiller's pendulum apparatus, room H.

4 p. m.—Lecture to science-teachers, by Prof. T. F. Pigot, on "Geometrical and Engineering Drawing," conference-room.

## SATURDAY.

7 p. m.—Specimens of glass with metals fused into them by lightning, room F.

8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Mr. W. Chandler Roberts, F. R. S., on "Graham's Apparatus," conference-room.

## PROGRAMME FOR THE WEEK ENDING SATURDAY JULY 29, 1876.

## EVERY DAY.

10 a. m. to 1 p. m.; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machines at work, room F; Pictet's ice-making machine at work in engine-house, room F.

## MONDAY.

10 a. m.—Lecture to science-teachers, by Dr. W. H. Stone, on "Instruments for experiments on sound," lecture-theater, South Kensington Museum.

3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H; musical instruments, room Q.

4 p. m.—Bosanquet's enharmonic harmonium, room Q; Holmes's fog horns, room E; lecture to science-teachers by Prof. J. P. O'Reilly, on "Apparatus for mining-surveying," lecture-theater, science-schools.

5 p. m.—Hayward Tyler and Co.'s "Universal" steam-pumps, room C.

7.30 p. m.—Post-Office telegraphic apparatus, room F.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Mr. J. N. Douglas, "The light-houses on the Great and Little Basses Rocks, Ceylon," conference-room.

## TUESDAY.

10 a. m.—Lecture to science-teachers, by Dr. W. H. Stone, on "Musical instruments and Temperaments," lecture-theater, South Kensington Museum.

2.30 p. m.—George's ventilating stove, laboratory adjoining room G.

3 p. m.—Explanation of Russian instruments, room F; spectrum of electric light, room F.

4 p. m.—Lecture to science-teachers, by Prof. J. P. O'Reilly, on "Apparatus for mining-surveying," lecture-theater, science schools; Sugg's photometer, landing of south staircase.

6.30 p. m.—Mr. Etler's electric machine, conference-room.

7 p. m.—Tisley and Spiller's pendulum apparatus, room H.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Prof. N. J. Maskelyne, F. R. S., "What is a crystal? Answers drawn from the loan collection," conference-room.

## WEDNESDAY.

10 a. m.—Lecture to science-teachers, by Prof. G. Carey Foster, B. A., F. R. S., on "Electric measurement," conference-room.

3 p. m.—Magnetic observatory, outside room K.

4 p. m.—Lecture to science-teachers by Professor Flower, F. R. S., on "Museum specimens for teaching purposes," conference-room.

## THURSDAY.

10 a. m.—Lecture to science-teachers, by Dr. Siemen's, F. R. S., on "Measurement of density, bathometer," &c., conference room.

12 noon.—Demonstration by Sir J. Whitworth of his apparatus.

3 p. m.—Major Ross's blowpipe apparatus, laboratory adjoining room G.

4 p. m.—Holmes's fog-horns, room E; lecture to science-teachers by Mr. Baillie Hamilton, on "New musical instruments," conference-room.

## FRIDAY.

10 a. m.—Lecture to science-teachers, by Prof. Story Maskelyne, M. A., F. R. S., on "Mineralogical apparatus," conference-room.

11 a. m.—Tisley and Spiller's pendulum apparatus, room H.

4 p. m.—Lecture to science-teachers by Dr. Huggins, F. R. S., "The spectroscope applied to astronomy," lecture-theater, science-schools.

## SATURDAY.

8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Captain Davis, R. N., on "Arctic discoveries as illustrated by the maps and charts in the collection."

## PROGRAMME FOR THE WEEK ENDING SATURDAY, AUGUST 5, 1876.

## EVERY DAY.

10 a. m. to 1 p. m.; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machines at work, room F; Pictet's ice-making machine at work in engine-house, room F.

## MONDAY.

10 a. m.—Lecture to science-teachers, by Professor Michael Foster, M. D., F. R. S., "Use of lecture experiments in biological teaching," lecture-theater, science-school.

2 p. m. to 5 p. m.—The magneto-electric machine, by Gramme, and the electric light, room F.

3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H.; musical instruments, room Q.

4 p. m.—Holmes's fog-horns, room E; lecture to science-teachers, by Mr. W. Chandler Roberts, F. R. S., "Graham's researches," lecture-theater, science-schools.

7.30 p. m.—Post-office telegraphic apparatus, room F.

6 p. m. to 9 p. m.—Little Bassetts Rock light-house lighted, outside room K.

8 p. m.—Lecture by Professor G. Carey Foster, F. R. S., "Electricity as a motive power," conference-room.

#### TUESDAY.

10 a. m.—Lecture to science-teachers, by Major Wilson, R. E., F. R. S., "Surveying instruments," lecture-theater, South Kensington Museum.

2.30 p. m.—Lightning-conductors, (Dr. Mann,) room F.

3 p. m.—Spectrum of electric light, room F.

4 p. m.—Sugg's photometer, landing of south staircase.

7 p. m.—Tisley and Spiller's pendulum apparatus, room H.

8 p. m. to 9 p. m.—Little Bassetts Rock light-house lighted, outside room K.

#### WEDNESDAY.

10 a. m.—Lecture to science-teachers, by Major Wilson, R. E., F. R. S., "Surveying instruments," conference-room.

3 p. m.—Magnetic observatory, outside room K.

4 p. m.—Lecture to science-teachers by Mr. R. H. Scott, M. A., F. R. S., "Meteorological apparatus," conference-room.

#### THURSDAY.

10 a. m.—Lecture to science-teachers, by Professor Burdon Sanderson, M. D., LL. D., F. R. S., "Recording instruments," conference-room.

2 p. m. to 5 p. m.—The magneto-electric machine, by Gramme, and the electric light, room F.

4 p. m.—Holmes's fog-horns, room E.

Lecture to science-teachers, by Mr. R. H. Scott, M. A., F. R. S., "Meteorological apparatus," conference-room.

#### FRIDAY.

10 a. m.—Lecture to science-teachers, by Dr. Lauder Brunton, F. R. S., "Apparatus for physiological chemistry," conference-room.

11 a. m.—Tisley and Spiller's pendulum apparatus, room H.

4 p. m.—Lecture to science-teachers, by Mr. Vines, B. A., "Apparatus for vegetable physiology," conference-room.

#### SATURDAY.

3 p. m.—Mr. Pichler's instruments for illustrating harmony and discord, room Q.

8 to 9 p. m.—Little Bassetts Rock light-house lighted, outside room K.

8 p. m.—Lecture by Capt. J. E. Davis, R. N., F. R. G. S., on "Antarctic discoveries as illustrated by the maps and charts in the collection," conference-room.

#### PROGRAMME FOR THE WEEK ENDING SATURDAY, AUGUST 12, 1876.

##### EVERY DAY.

10 a. m. to 1 p. m.; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machine at work, room F; Pictet's ice-making machine at work in engine-house, room F.

##### MONDAY.

10 a. m.—Lecture to science-teachers, by Professor Goodeve, M. A., "End measurement," lecture-theater, science-schools.

12 noon.—Barlow's patent motometer, (Mr. Faija,) room F.

2 p. m. to 5 p. m.—The Gramme magneto-electric machine and the electric light, room F.

3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H, and musical instruments, room Q.

4 p. m.—Holmes's fog-horns, room E; lecture to science-teachers, by Professor Burdon Sanderson, M. D., LL. D., F. R. S., "Astronomical instruments," lecture-theater, South Kensington Museum.

7.30 p. m.—Post-office telegraphic apparatus, room F.

8 p. m. to 9 p. m.—Little Bassetts Rock light-house lighted, outside room K.

8 p. m.—Lecture by Prof. Herbert McLeod, "Some properties of gases," conference-room.

##### TUESDAY.

10 a. m.—Lecture to science-teachers, by Professor Goodeve, M. A., "Conversion of motion," lecture-theater, science-schools.



- 2.30 p. m.—Solid-flame burners, (Dr. Mann,) laboratory adjoining room G.  
 3 p. m.—Spectrum of electric light, room F.  
 4 p. m.—Sugg's photometer, landing of south staircase; lecture to science-teachers, by Professor Ball, LL. D., F. R. S., "Astronomical instruments," conference-room.  
 7 p. m.—Tisley and Spiller's pendulum apparatus, room H.  
 8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

## WEDNESDAY.

- 10 a. m.—Lecture to science-teachers, by Professor Goodeve, M. A., "Illustrations of applied mechanics," lecture-theater, science-schools.  
 3 p. m.—Magnetic observatory, outside room K.  
 4 p. m.—Lecture to science-teachers, by Professor Ball, LL. D., F. R. S., "Calculating machines," conference-room.

## THURSDAY.

- 10 a. m.—Lecture to science-teachers, by Mr. Sorby, F. R. S., "Microscopes," conference-room.  
 2 p. m. to 5 p. m.—The Gramme magneto-electric machine and the electric light, room F.  
 4 p. m.—Holmes's fog-horns, room E; lecture to science-teachers, by Mr. Bottomley, "Electrometers," conference-room.

## FRIDAY.

- 10 a. m.—Lecture to science-teachers, by Dr. H. E. Armstrong, "Organic chemistry," conference-room.  
 11 a. m.—Tisley and Spiller's pendulum apparatus, room H.  
 4 p. m.—Lecture to science-teachers, by Mr. Bottomley, "Electrometers," conference-room.

## SATURDAY.

- 3 p. m.—Mr. Pichler's instruments for illustrating harmony and discord, room Q.  
 5 p. m.—M'Kay's patent equilibrium drill, room C.  
 8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.  
 8 p. m.—Lecture by Mr. W. S. Mitchell, M. A., "The rise of stratigraphical geology in England and some of its practical results," conference-room.

## PROGRAMME FOR THE WEEK ENDING SATURDAY, AUGUST 19, 1876.

## EVERY DAY.

- 10 a. m. to 1 p. m.; 2 p. m. to 4 p. m.—The "Times" composing and type-casting machine at work, room F; Pictet's ice-making machine at work in engine-house, room F.

## MONDAY.

- 10 a. m.—Lecture to science-teachers, by Professor Barrett, "Simple apparatus for teaching physics," lecture-theater, science-schools.  
 3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H; musical instruments, room Q.  
 4 p. m.—Lecture to science-teachers, by Professor Geikie, F. R. S., "Geological maps and apparatus for surveying," lecture-theater, South Kensington Museum.  
 7.30 p. m.—Post-office telegraphic apparatus, room F.  
 8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.  
 8 p. m.—Lecture by Mr. W. J. Harrison, F. G. S., on the "Study of Local Geology with Illustrations from Leicestershire," conference-room.

## TUESDAY.

- 10 a. m.—Lecture to science-teachers, by Prof. George Forbes, "Thermo-dynamics, specific and latent heat," lecture-theater, science-schools.  
 2.30 p. m.—Lowne's ventilation anemometer, (Dr. Mann,) laboratory adjoining room G.  
 4 p. m.—Sugg's photometer, landing of south staircase; lecture to science-teachers, by Professor Geikie, F. R. S., "Geological maps and apparatus for surveying," conference-room.  
 7 p. m.—Tisley and Spiller's pendulum apparatus, room H.  
 8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K; lecture by Prof. E. Hull, F. R. S., "The physical geology of Ireland as compared with that of England," conference-room.

## WEDNESDAY.

- 10 a. m.—Lecture to science-teachers, by Professor Kennedy, C. E., "Kinematical models," conference-room.  
 3 p. m.—Magnetic observatory, outside room K.

4 p. m.—Lecture to science-teachers, by Mr. Froude, M. A., F. R. S., "The laws of fluid resistance as they affect ships," conference-room.

## THURSDAY.

10 a. m.—Lecture to science-teachers, by Professor Kennedy, C. E., "Kinematical models," conference-room.

4 p. m.—Lecture to science-teachers, by Mr. Froude, M. A., F. R. S., "Propulsion of ships," conference-room.

## FRIDAY.

10 a. m.—Lecture to science-teachers, by Professor Barrett, "Sources of electricity," lecture-theater, science-schools.

11 a. m.—Tisley and Spiller's pendulum apparatus, room H.

4 p. m.—Lecture to science-teachers, by Prof. George Forbes, "Conduction of heat," conference-room.

## SATURDAY.

3 p. m.—Mr. Pichler's instruments for illustrating harmony and discord, room Q; Major Ross's blowpipe apparatus, laboratory adjoining room G.

6 p. m.—Mr. Etler's electric machine, conference-room.

8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Prof. W. F. Barrett, "Experiments illustrating the analogy between light and sound."

## PROGRAMME FOR THE WEEK ENDING SATURDAY, AUGUST 26, 1876.

## EVERY DAY.

10 a. m. to 1 p. m., 2 p. m. to 4 p. m.—The "Times" composing and type-casting machines at work, room F; Pictet's ice-making machine at work, in engine-house, room F.

## MONDAY.

12 noon.—Barlow's patent motometer, (Mr. Faija,) room F.

3 p. m.—Sir J. Whitworth's measuring-machine and testing-machine, room H; musical instruments, room Q.

7.30 p. m.—Post-office telegraphic apparatus, room F.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Mr. W. Spottiswoode, F. R. S., "Experimental illustrations of polarized light," Lecture Theatre, South Kensington Museum.

## TUESDAY.

2.30 p. m.—George's ventilating stove, laboratory adjoining room G.

4 p. m.—Sugg's photometer, landing of south staircase.

4.30 p. m.—Apparatus lent by the hydrographic department of the admiralty, room K.

7 p. m.—Tisley and Spiller's pendulum apparatus, room H.

8 p. m. to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

## WEDNESDAY.

3 p. m.—Magnetic observatory, outside room K.

## THURSDAY.

## FRIDAY.

11 a. m.—Tisley and Spiller's pendulum apparatus, room H.

## SATURDAY.

3 p. m.—Mr. Pichler's instruments for illustrating harmony and discord, room Q; Major Ross's blowpipe apparatus, laboratory adjoining room G.

4 p. m.—Dynamic anemometer, (Aeronautical Society,) room H.

6 p. m.—Mr. Etler's electric machine, conference-room.

8 to 9 p. m.—Little Basses Rock light-house lighted, outside room K.

8 p. m.—Lecture by Mr. J. Baillie Hamilton, "New musical instruments," Lecture Theatre, South Kensington Museum.

## PROGRAMME FOR THE WEEK ENDING SATURDAY, SEPTEMBER 2, 1876.

## EVERY DAY.

10 a. m. to 1 p. m., 2 p. m. to 4 p. m.—Pictet's ice-making machine at work, in engine-house, room F.

## MONDAY.

2 to 5 p. m.—The Gramme magneto-electric machine and the electric light, room F.  
 3 p. m.—Musical instruments, room Q.  
 8 p. m.—Lecture by Mr. H. W. Chisholm, "Standard weights and measures," conference-room.

## TUESDAY.

4 p. m.—Sugg's photometer, landing of south staircase.  
 7 p. m.—Tisley and Spiller's pendulum apparatus, room H.

## WEDNESDAY.

3 p. m.—Magnetic observatory, outside room K.

## THURSDAY.

2 to 5 p. m.—The Gramme magneto-electric machine and the electric light, room F.

## SATURDAY.

3 p. m.—Mr. Pichler's instruments for illustrating harmony and discord, room Q;  
 Major Ross's blowpipe apparatus, conference-room.  
 6 p. m.—Mr. Etler's electric machine, conference-room:

**No. 13.—REPORT OF REAR-ADMIRAL THORNTON A. JENKINS,  
 U. S. N., INTERNATIONAL CENTENNIAL EXHIBITION, 1876.**

INTERNATIONAL EXHIBITION, 1876,  
 BOARD ON BEHALF OF U. S. EXECUTIVE DEPARTMENTS,  
 OFFICE OF THE REPRESENTATIVE OF THE NAVY DEPARTMENT,  
 3703 *Hamilton street, Philadelphia, November 27, 1876.*

SIR: I have the honor, and very great pleasure, to report that the naval branch of the International Centennial Exhibition of 1876 (which formed a very small part, however, of the entire exhibition, which was formally opened on May 10 and formally closed on November 10) proved a greater success than some of its contributors and warmest friends had in the earlier days of the undertaking hoped for.

The deep interest manifested by yourself from the first in the success of the naval exhibition, and your continued anxiety that nothing should be omitted or left undone that could in any way conduce to or add to its success strengthened the hands and gave great encouragement to myself and my associates on centennial duty.

Without assuming to pass judgment upon the professional or popular estimate, as mere exhibits, of the articles and objects arranged in the naval section of the Government building, I may be permitted to say that the opinions of all classes of persons, so far as I have heard, have been most favorable and greatly to the credit of the naval department and naval service of the country.

On the 5th of May (five days in advance of the formal opening of the exhibition) the exhibits in the naval section were arranged and in the main labeled in English, French, and German, showing sections, classes, numbers, names, and descriptions of each object. A catalogue, embracing every object on exhibition, was prepared and widely distributed among the different foreign commissioners and the representatives of the different States and Territories of the United States.

A few weeks prior to the closing of the exhibition the very unique and highly interesting exhibits presented by His Majesty the King of Siam to the United States, through Rear-Admiral Reynolds (commanding Asiatic station) and the Navy Department, were received at the Government building, and within a week these curious, wonder-inspir-

ing articles were all arranged in cases and on tables, all properly labeled, and a catalogue made out.

I beg leave to inclose herewith a synoptical table of the naval exhibits and to refer to the printed catalogue for further information on the subject.

I beg leave also to refer to the printed catalogue of the Siamese collection for information which could not well find a place in a short report to the Department.

I trust I may be permitted to say in conclusion that, whatever may have been the misgivings as to probable success in the outset of the undertaking, the naval exhibits at the International Centennial Exhibition of 1876 have been most creditable to the Navy Department, to its distinguished head, to the chiefs of bureaus, and others, who furnished the articles.

I am, sir, very respectfully, your obedient servant,  
**THORNTON A. JENKINS,**  
*Rear-Admiral, U. S. N.,*  
*Representative Navy Department,*  
*Centennial Exhibition of 1876.*

Hon. GEORGE M. ROBESON,  
*Secretary of the Navy, Navy Department, Washington, D. C.*

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*Synoptical list of the naval exhibits in the United States Government building, Fairmount Park, Philadelphia.*

**SECTION 1.—NAVAL ORDNANCE, ETC.**

*Fac simile* of a "monitor" revolving turret, with two XV-inch guns inside—one on an Eads's steam-carriage, and the other an Ericsson's carriage, complete.

CLASS A.—Heavy ordnance, from XV-inch to the smaller calibers.

CLASS B.—Different calibers of howitzers and Gatling guns.

CLASS C.—Small-arms, old and new.

CLASS D.—Projectiles of every caliber, sections of shells, old and new, &c.

CLASS E.—

CLASS F.—Loading-gear, cannon-locks of different periods; fuses of different kinds and times, and numerous vent-impressions after cannon-firing.

CLASS G.—Models of ordnance, ordnance implements, and utensils of the past and present.

CLASS H.—Ordnance relics.

CLASS I.—Ordnance publications.

CLASS K.—Torpedoes of different kinds used, or proposed to be used: batteries, wires, and all the instruments and appliances used in the torpedo-service; plans of torpedo-station.

CLASS L.—Apparatus for measuring the force of projectiles.

CLASS M.—Dresses and arms of seamen and marines from 1776 to 1876, inclusive.

CLASS N.—Specimens of the different kinds and sizes of gunpowder.

**SECTION 2.—NAVIGATION.**

CLASS A.—Nautical and surveying instruments used in the United States Navy, embracing chronometers, compasses, magnetic collimator, adjustable binnacle, gravitation-compasses, &c.

**CLASS B.**—Logs for measuring the speed of vessels; sounding-leads, lines, and mechanical sounding-apparatus.

**CLASS C.**—Side and head lights for vessels at sea; deck, cabin, and other lamps, &c.; lanterns used on board ship.

**CLASS D.**—Charts published at the Hydrographic Office of the Navy Department.

**CLASS E.**—Nautical books published and used in the United States Navy.

**CLASS F.**—National flags, embracing those from 1775 to 1876, complete; officers' flags, signal-flags, American bunting, and American seamless flags.

**CLASS G.**—Publications of United States Naval Observatory from its organization to 1876.

**CLASS H.**—Three buildings, *fac similes* of those used in observing the transit of Venus, with a sidereal clock, and the other instruments actually used by the observers at the different stations.

**CLASS I.**—Relics, photographs, charts, maps, medals, journals, reports, &c., relating to or obtained from the Arctic regions during the different American Arctic voyages of exploration and discovery.

**CLASS K.**—The American Nautical Almanac and nautical almanac publications to 1876.

**CLASS L.**—Relics of Captain John Paul Jones, of the Continental Navy.

### SECTION 3.—EQUIPMENT.

**CLASS A.**—Ships' galleys—modern.

**CLASS B.**—From the rope-walk of the Boston navy-yard: American and Russian hemp rope, Manila and other grass rope, and small stuff of different sizes, including a hemp cable of 25 inches; specimens of the different hemp and other fibers used in the Navy for making rope.

**CLASS C.**—Wire rope, made at the Boston navy-yard, of all the different sizes of hawsers to the smallest size made anywhere.

**CLASS D.**—Specimens of chain cables; shackles for chain cables, anchor-buoys, link and shackle bending machine in use at Washington navy-yard, &c.

**CLASS E.**—Specimens of cotton and hemp canvas of different numbers used in the Navy.

**CLASS F.**—Hoisting-gear.

**CLASS G.**—Specimens of iron which have been subjected to test by a commission under orders of the Navy Department.

### SECTION 4.—YARDS AND DOCKS.

**CLASS A.**—Model of stone dry-docks at Kittery, Me., Boston, Mass., New York, Norfolk, Va., and Mare Island, Cal., navy-yards.

**CLASS B.**—Specimens of oak taken from different historical vessels of the Navy.

**CLASS C.**—Plans of different navy-yards, dry-docks, cranes, derricks, &c.

### SECTION 5.—CONSTRUCTION AND REPAIR.

**CLASS A.**—Models of vessels of war, old and new.

**CLASS B.**—Bent knees for ship-building.

**CLASS C.**—Relic of the ship Philadelphia from Tripoli, Africa, and of the Lawrence from Lake Erie; relic of the Kearsarge.

## SECTION 6.—MEDICINE AND SURGERY.

**CLASS A.**—Complete set of surgical instruments, set of surgical appliances, hospital-stores, dispensary furniture, model of sick-bay, model of hospital ship, articles for sanitary purposes used on board vessels of war, photographs of the different naval hospitals, stationery, blank books, forms, &c.

## SECTION 7.—PAY, PROVISIONS, AND CLOTHING.

**CLASS A.**—Specimens of the different articles composing the Navy ration.

**CLASS B.**—Specimens showing original packages as prepared for sea.

**CLASS C.**—Specimens of uniform clothing used by seamen in the Navy.

**CLASS D.**—Small stores served to the men on board vessels of war, such as tea, coffee, sugar, tobacco, pepper, &c.; tape, needles, pins, sewing materials, &c.

**CLASS E.**—Stationery, blank forms, books, returns, &c.

## SECTION 8.—STEAM-ENGINEERING.

**CLASS A.**—Two marine steam-engines, two tubular steam-boilers, steam-cutter engines, steam-cutter propellers, fresh-water-distilling apparatus, filtering apparatus for fresh water, indicators, salimeters, tools, implements, gum packings, drawings of engines and boilers, photographs, &c., of steam machinery.

## SECTION 9.—PORTRAITS OF DISTINGUISHED DECEASED NAVAL OFFICERS.

Forty-one portraits of distinguished deceased naval officers, commencing with Commodore Esek Hopkins, the first commander-in-chief of the Continental Navy in 1775.

Two portraits of representative petty officers of former times.

## No. 14.—DETAILED MOVEMENTS OF VESSELS.

## NORTH ATLANTIC STATION.

The force on this station is now under the command of Rear-Admiral S. D. Trenchard, who relieved Rear-Admiral William E. Le Roy on the 31st of August, 1876. Rear-Admiral J. R. M. Mullany, who was in command of the station at the last report, was relieved by Rear-Admiral Le Roy on the 14th of February, 1876.

The flag of Rear-Admiral Mullany was transferred from the Worcester to the Hartford on the 5th of January, and the Worcester was put out of commission as a cruiser on the 18th of that month.

The force on the station consists of the Hartford, (flag-ship,) 18 guns; Plymouth, 12 guns; Swatara, 8 guns; Ossipee, 8 guns; Adams, 6 guns; Essex, 6 guns; Huron, 4 guns; Ranger, 4 guns; Shawmut, 3 guns; New Hampshire, store-ship at Port Royal; Pawnee, hospital-ship at the same place; tug Seaweed; and the iron-clads Ajax, 2 guns; Catskill, 2 guns; Dictator, 2 guns; Canonicus, 2 guns; Lehigh, 2 guns; Mar-

hattan, 2 guns; Mahopac, 2 guns; Montauk, 2 guns; Passaic, 2 guns; Saugus, 2 guns; and Wyandotte, 2 guns.

The Brooklyn, Monongahela, Congress, Marion, Vandalia, Alert, and Pinta were also attached to the station part of the year.

The Hartford arrived at Norfolk, Va., from New York, on the 24th of December, 1875, and the flag of Rear-Admiral Mullany was hoisted on board January 5, 1876.

On the 14th of February, Rear-Admiral William E. Le Roy hoisted his flag, and on the 9th of March left Norfolk for Hampton Roads, Va., to organize the fleet, &c. On the 14th, a battalion of men was landed at Fortress Monroe and drilled with satisfactory results. The battalion consisted of men from the Hartford, Plymouth, Marion, Vandalia, and Huron, and was composed of 8 companies of blue-jackets, 288 men; 3 companies of marines, 102 men; and 6 howitzers, 126 men; total, 516 men.

On the 21st of March sailed for Port Royal, S. C., arriving there about the 27th. On the 23d of April sailed for Key West, Fla., and departed thence May 2 for Tampico, but touched at Brazos Santiago, Texas, the admiral having received information rendering that course necessary. After remaining there until the 15th, left for Tampico, and reached that place on the 22d. Finding American interests not in immediate danger, sailed June 14, and arrived at Port Royal on the 27th. On the 8th of July proceeded to Philadelphia, arriving on the 12th, and remained until September 26, on duty in connection with the Centennial Exhibition. Rear-Admiral S. D. Trenchard relieved Rear-Admiral Le Roy of the command of the station, and hoisted his flag on the 31st of August. The Hartford left on the 26th of September, and anchored at Hampton Roads the next day, where she still remains.

The Plymouth left the navy-yard, Norfolk, December 14, 1875, and dropped down to an anchorage off the flag-ship, Norfolk, thence to Hampton Roads March 9, 1876; sailed for Port-au-Prince on the 15th, in company with the Vandalia, and arrived there on the 26th. Left Port-au-Prince on the 22d of April, and arrived at Kingston, Jamaica, on the 27th, remaining there until the 2d of May, and leaving on that day, touching at Cape Mole, St. Nicola, Haiti, Genoine, St. Marks, and thence back to Port-au-Prince, reaching the last-named place on the 7th. Left on the 8th, bound to St. Domingo and other ports, where she touched, and returned to Port Royal on the 5th of June. Sailed for Charleston, S. C., and gave the crew liberty, and on the 8th of July left for New York, and reached there on the 14th, departing thence on the 28th. Arrived at Halifax on the 3d of August, remained until the 12th, touched at Gloucester on the 15th, and, leaving there on the 17th, reached Boston the same day. Left on the 25th, touched at Gardiner's Bay, and returned to New York on the 30th. On the 19th of September sailed for Philadelphia, which port she reached on the 21st. Remained there on duty in connection with the Centennial Exhibition, relieving the Hartford, until the 21st of November, when she left in company with the Essex, and anchored in Hampton Roads November 23, where she remains.

The Ossipee left Port Royal about February 16 for Pensacola, Fla., and arrived there on the 29th. Sailed on the 12th of April for a short cruise to Cuba, returning to Pensacola on the 23d; and left on the 25th for Port Royal, with the iron-clad Manhattan, reaching that port on the 2d of May. Sailed from Port Royal, on account of sanitary reasons, on the 16th, for Portland, Me., arriving there on the 27th, and remaining there until the 5th of July. Left on that day, touched at Mount Desert,

and arrived at Boston on the 10th, which port she left on the 23d, and anchored at Hampton Roads on the 27th. On the 14th of October she proceeded to New Orleans, La. On her way she put into Key West for coal, having encountered a hurricane, but sustained damages of no great extent; sailed on the 25th, and reached New Orleans, where she now is.

The Swatara left Para, Brazil, December 3, 1875, whither she had gone to offer passage to the United States to indigent Americans there; arrived at Port Royal, S. C., December 27, and joined the station. In February, 1876, departed for Pensacola, reaching that port on the 29th; and leaving on the 27th of March, with the iron-clad Mahopac, for Port Royal, where she arrived on the 10th of April. On the 21st, left for a cruise to Key West and the Gulf of Mexico. May 2, arrived at Key West from Havana, and departed thence for Tampico, Mexico; left there about the 31st for a cruise to the southward, to touch at Tuspan on her way to Vera Cruz. On the 13th of July, returned to Port Royal from cruise, having visited all the ports on the coast of Mexico from Truxpan to Tobasco, and on the 20th left for Halifax, which port she reached on the 26th. Left on the 8th of August for Portland, Me., Boston, Newport, and New York; visited those ports, and arrived at the last-named on the 6th of September, and remains there.

The Adams was put in commission at Boston on the 21st of July, and left for Philadelphia on the 6th of August. Arrived at Philadelphia on the 9th, and joined the station. On the 4th of September departed for Norfolk; arrived on the 6th, and left on the 16th for Hampton Roads, where she remained until the 17th of November, when she sailed for Port Royal.

The Essex was put in commission at Boston on the 3d of October, and sailed for Philadelphia on the 24th, reaching that port on the 28th. On the 21st of November left for Hampton Roads, and arrived there on the 23d, where she remains.

The Huron reported at Norfolk December 17, 1875, for duty on the station, and on the 9th of February, 1876, was ordered to Hampton Roads. March 21, left for Port Royal, S. C., arriving there on the 27th. On the 10th of April sailed for Vera Cruz, where she arrived on the 24th. Left there, and arrived at Key West on the 10th of June for coal and provisions, and returned to Vera Cruz, reaching there on the 28th. July 1, left Vera Cruz and visited Frontera, Tobasco, Santa Anna, and other ports, returning on the 21st. August 4, arrived at Port Royal, and sailed on the 13th for Portsmouth, N. H.; arrived on the 18th, and left on the 26th for Boston; reached there on the 28th, and sailed on the 16th September for Hampton Roads, where she remains.

The Shawmut left Aspinwall December 4, 1875, and arrived at Key West on the 13th. In February, 1876, ordered to Pensacola; arrived there on the 1st of March, and left on the 21st with the iron-clad Ajax for Port Royal, reaching there on the 7th of April. Left on the 19th, and reached Tampico, Mexico, on the 4th of May. Left on the 1st of June for Key West for coal and provisions; arrived there on the 14th, and returned to Tampico on the 24th; departed thence on the 3d of July, and visited Tuxpan and Vera Cruz, arriving at Key West on the 1st of August; sailed for Port Royal on the 3d, arrived the 7th, and left the next day for New London, Conn.; remained there until the 9th of September; sailed that day for New York, arriving the next day, and continuing there until the 30th, when she departed for Hampton Roads, reaching there October 2d, where she remains.

The New Hampshire left Norfolk May 10th, in tow of the Powhatan.



for Port Royal, arrived on the 15th, and remained there as a store-ship.

The Pawnee has continued at Port Royal since April 13, 1875, and is used as a hospital-ship.

The iron-clad Dictator remains at Port Royal, and the iron-clad Canonicus at New Orleans. The iron-clads Catskill, (arrived in March,) Ajax, (arrived April 7,) Mahopac, (arrived April 10,) Saugus, (arrived April 14,) Manhattan, and Lehigh, (arrived May 2,) having been convoyed from the Pensacola and Norfolk navy-yards, remain at Port Royal.

The iron-clads Wyandotte, Passaic, and Montauk left Norfolk and anchored in Hampton Roads November 24.

The Brooklyn arrived at Port Royal February 14, left April 22 for Norfolk, reached there on the 25th, and departed on the 22d of June for New York, and arrived there on the 30th, and was put out of commission on the 21st of July.

The Congress arrived at Port Royal January 17, left in the latter part of April for Philadelphia, reaching that port May 6, remained there on duty connected with the Centennial Exhibition, (furnishing four companies of sailors as escort to the President of the United States on the opening day,) until July 10, sailed on that day, and arrived at Portsmouth, N. H., on the 14th, and was put out of commission on the 26th.

The Monongahela arrived at Port Royal February 14, left and arrived at Pensacola on the 29th, and sailed thence April 6, with the iron-clad Saugus, for Port Royal, arriving there on the 13th. On the 24th, for sanitary reasons, was ordered to Portland, Me., where she arrived in May, and from thence sailed to Newport, R. I., arriving there June 13, and after a short stay left for Norfolk, which port she reached and was put out of commission July 15. On the 6th of September was put in commission as a training-ship.

The Marion was put in commission at Portsmouth, N. H., January 12, and sailed on the 22d for Norfolk, Va., arriving at that navy-yard February 9, and left on the 28th, when she joined the station at Hampton Roads, left on the 21st March, and reached Port Royal on the 27th, departed thence on the 19th April for Tampico, Mexico; reached Key West April 21st, and left for the Rio Grande April 22; May 10, at Brazos, Texas, which place she left on the 29th for Tampico, arriving there on the 31st. June 4th departed for Key West, arriving there on the 20th, and sailed on the 23d for Lisbon, Portugal, to join the European station.

The Vandalia was put in commission at Boston, Mass., on the 10th of January, and sailed for Norfolk on the 4th of February, and arrived about the 7th. On the 15th of March left Hampton Roads for Port-au-Prince, and reached that port on the 27th. Left on the 7th April for Jacmel, Hayti, arrived on the 9th, and departed same day for Kingston, Jamaica, where she anchored on the 11th, and, having taken in coal and provisions, proceeded on the 19th back to Port-au-Prince, arriving on the 22d. Left on the 8th of May for Aspinwall, at which place arrived on the 15th, departed thence June 10 for a brief cruise to St. Andrew's Island at the suggestion of the United States consul, and returned to Aspinwall on the 17th. On the 2d of June a party of officers, blue-jackets, and marines from the ship, with Colombian troops, participated in the funeral ceremonies of the late Rear-Admiral Napoleon Collins, United States Navy. Left Aspinwall July 14, and reached Port Royal on the 25th, departed thence on the 29th, and arrived at New York August 2d, and on the 9th of September left to join the European station.

The Alert left Norfolk February 25 with the iron-clad Catskill for

Port Royal, S. C., and arrived there about 8th of March, and on the 31st departed for New York, reaching there on the 8th of April, and left on the 26th of May to join the Asiatic station.

The *Pinta* left Port Royal in February, and arrived at Norfolk on the 29th of that month with invalids, &c., from Port Royal, and was put out of commission on the 17th of April.

The *Ranger* was put in commission at Wilmington, Del., on the 27th November.

#### SOUTH ATLANTIC STATION.

The force at this station is now under the command of Commodore C. H. B. Caldwell, and consists of the *Richmond*, flag-ship, 14 guns, the former flag-ship of the South Pacific station, and the *Frolic*.

The *Richmond* arrived at Montevideo, Uruguay, October 21, having left Valparaiso, Chili, September 12.

The *Frolic* arrived at Rio de Janeiro, Brazil, from the United States in the latter part of November, 1875; left about December 12, and reached Montevideo, Uruguay, on the 21st, and took the place on the station of the *Wasp*, which was condemned and sold. During the year the *Frolic* has been engaged in visiting Maldonado, Colonia, Ensenada, Buenos Ayres, Montevideo, and other ports within the limits of the station.

#### EUROPEAN STATION.

The following vessels comprise the force on the European station, under command of Rear-Admiral John L. Worden: *Marion*, 7 guns; *Vandalia*, 8 guns.

The *Franklin*, (flag-ship,) 39 guns, and the *Alaska*, 12 guns, were attached to the station most of the year.

The *Franklin* arrived at Lisbon on the 8th of December, 1875, and, remaining there until the 19th of February, 1876, left on that day for Southampton, England; arrived on the 25th; departed thence on the 14th of March for Cherbourg, France, which port she reached on the 17th, and left on the 22d for Gibraltar, where she arrived on the 30th. On the 7th of April departed for Villefranche; reached there on the 12th; sailed thence on the 16th of May, and arrived at Salonica, Turkey, on the 24th. Left that port June 5th, and visited Smyrna, Turkey; Beyrout, Syria; and Messina, Sicily, remaining a few days at each of these places, and returning to Villefranche on the 4th of July, where she remained until the 13th, when she sailed for Leghorn, which port she reached on the 15th. On the 29th of August left, and same day arrived at Spezia, continuing there until the 8th of September, when she left for Villefranche, arriving there the next day. On the 14th she departed for Gibraltar, on her return to the United States, reaching there on the 20th, and leaving on the 24th for Vigo, Spain. She arrived at Vigo on the 26th, and on the 28th sailed for the United States. She reached New York on the 23d of November via St. Thomas.

The *Marion* left Key West June 23, and arrived at Lisbon on the 18th of July; departed thence on the 26th for Leghorn, reaching there August 3, and remaining until the 14th; left on that day for Smyrna; arrived on the 21st, and departed thence on the 24th for Constantinople, arriving there the 26th. On the 6th of September sailed for Villefranche, and arrived on the 13th, and departed on the 18th for Spezia, entering that port the next day. On the 22d left for Genoa, and arrived the same day, where she remains.

The *Vandalia* left New York on the 9th of September, and arrived at Lisbon on the 5th of November, where she was at the last report.

The *Alaska* arrived at Lisbon on the 6th of December, 1875, and on the 1st of January following made a cruise to the coast of Africa on account of troubles in Liberia. Having successfully accomplished the object of her cruise, she left the Gaboon River on the 5th of April, and reached Funchal, Madeira, on the 12th of June; leaving there, and touching at Gibraltar, she arrived at Villefranche on the 6th of July. On the 13th she departed for Genoa, arriving the next day, and remaining until the 3d of August, when she sailed for the United States; arrived at Boston September 20; left the same day, and reached New York on the 25th, and was put out of commission October 5.

#### NORTH PACIFIC STATION.

The force on this station, under the command of Rear-Admiral Alexander Murray, consists at present of the *Pensacola*, (flag-ship,) 22 guns, and the *Lackawanna*, 10 guns.

The *Tuscarora* and *Portsmouth* were also attached to the station during the year.

Rear-Admiral John J. Almy was relieved of the command of this station on the 1st of July by Rear-Admiral Alexander Murray.

The *Pensacola* returned January 26 to San Francisco from her cruise to Lower California and the west coast of Mexico, having left Acapulco on the 27th of December, 1875. On the 19th of August, 1876, left the navy-yard, Mare Island, Cal., for a cruise along the Mexican and Central American coasts, and thence to Panama; arrived at Mazatlan, Mexico, September 10, and left that day for La Paz, reaching there on the 23d, and remained until about October 10, when sailed for Acapulco, arriving on the 21st *en route* to Panama, and reaching there about the 25th of November.

The *Lackawanna* sailed January 25 for La Paz and Lower California; arrived at San Blas, Mexico, February 10, and on the 14th steamed for Mazatlan, arriving the following day; from thence cruised along the west coast of Mexico, and visited Guaymas, La Paz, and Mazatlan; sailed thence for the Hawaiian Islands, and arrived at Honolulu about April 26, and cruised among those islands; left September 12 for Guaymas, La Paz, and other Mexican ports.

The *Tuscarora* has been engaged on deep-sea soundings between the Hawaiian and Fiji Islands, and also in inquiring into the possible abuse of our flag in kidnapping natives in the South Sea Islands, but found no cases of such abuse. She left the Fiji Islands 25th January, and arrived at Brisbane Roads, Australia, February 14, and cast soundings between those places; arrived at Sydney, Australia, March 9, and on the 11th left for the Samoan Islands; visited those islands, and inquired into and reported on the troubles there, and sailed for Honolulu, arriving there on the 27th of May; left on the 10th of June, and reached San Francisco July 3, and was put out of commission on the 14th of September.

The *Portsmouth*, on her return to the navy-yard, Mare Island, Cal., July 14, 1876, from a cruise to the west coast of Mexico, was put out of commission as a cruiser attached to the station, and was put in commission as a training-ship for boys, and continued on that duty until August 7, 1876, when she was put out of commission at the navy-yard, Mare Island.

## SOUTH PACIFIC STATION.

The vessels now on this station are the *Omaha*, 12 guns, and the *Onward*, 3 guns. The *Pensacola*, flag-ship of the North Pacific station, arrived at Panama about November 25, to cruise within the limits of this station.

The *Richmond*, former flag-ship, left Callao, Peru, on the 27th November, 1875, reaching Coquimbo, Chili, on the 7th of December, and departing thence on the 10th, arrived at Valparaiso the next day; left Valparaiso, April 4, 1876, and arrived at Coquimbo on the 6th; sailed and reached Callao, May 20. On the 13th of July, Commodore C. H. B. Caldwell relieved Rear-Admiral Reed Werden, who had been in command, since September 25, 1875, of the command of the station, and on the 12th of August the *Richmond* sailed from Callao for the South Atlantic station; went to Valparaiso and left on the 12th of September, touching at Valdivia for four days, and entering the Straits of Magellan on the 28th September; left October 7, and arrived at Montevideo, Uruguay, on the 21st.

The *Omaha* left Panama November 26, for Payta; thence to Callao and Valparaiso, arriving at the last-named port, February 12, 1876. On the 1st of March, sailed for Juan Fernandez, to make a survey of those islands, and returned on the 26th, having made a very accurate survey. Left Valparaiso about the 30th April, and arrived at Coquimbo, Chili, May 2; visited the ports of Caldera, Chili; Antofagasta and Cobija, Bolivia; Pabellon de Pica and Pisagua, coast of Peru, the *Omaha* being the first vessel of war that had anchored in the last-named port; Mollendo and Pisco, Peru; and sailing from Pisco July 14, arrived at Callao the next day. September 1, departed and reached Guayaquil, Ecuador on the 8th; sailed for Payta, Peru, after a stay at Guayaquil, reaching that port on the 30th, and remaining until the 16th of October, when sailed for Callao; arrived at Aucon, Peru, October 21, and, in obedience to order of Navy Department, left for Panama, arriving there on the 16th of November, where she remains.

The *Onward*, store-ship for the station, remains at Callao.

## ASIATIC STATION.

The force on this station, under the command of Rear-Admiral William Reynolds, consists of the *Tennessee*, (flag-ship,) 23 guns; *Kearsarge*, 6 guns; *Ashuelot*, 6 guns; *Monocacy*, 6 guns; *Yantic*, 3 guns; *Alert*, 4 guns, and *Palos*. The *Saco* was also attached to this station a part of the year.

The *Tennessee* arrived at Nagasaki from the United States November 30, 1875, having touched *en route*, and after having passed through the Suez Canal, at Aden, Bombay, Colombo, Penang, Singapore, Manila, Amoy, and Wusung. On the 27th January, 1876, left Nagasaki for Wusung, reaching there on the 30th, and leaving on the 11th February, arrived at Shanghai; remained there until March 30, and reached Yokohama, Japan, on the 8th of April, remaining there until the 5th of June, when sailed for Kobe, Japan, arriving there on the 7th. On the 6th of July left for Yokohama, reaching there the 7th, and departing on the 29th, arrived at Hakodadi, Japan, August 1. On the 19th, departed and returned to Yokohama, arriving on the 21st; left September 9, and reached Nagasaki on the 17th, and on the 19th sailed for Chefoo, where she arrived on the 22d, and intended to leave the same day for

New-chwang and the mouth of the Peiho, the admiral and officers proposing to visit Peking.

The Kearsarge, during the month of December, 1875, was at Nagasaki; left January 22, 1876, and arrived at Shanghai on the 26th, and remained there until March 22, when she sailed for Nagasaki, Hong-Kong, and Manila, reaching the last named on the 7th of April, having touched at the other ports; left on the 17th and returned to Hong-Kong, arriving there on the 20th; left July 10 for Swatow, and from thence sailed for Manila, and after remaining there returned to Hong-Kong; left August 10, reached Nagasaki August 15, sailed thence to Yokohama, arriving on August 20, and left September 9 for Vladivostock.

The Monocacy, during the month of December, 1875, was at Ningpo, and arrived at Shanghai January 30, and remained there, for new boilers and repairs, until May 30; left that day for Nagasaki and arrived June 2; departed thence June 6, and reached Kobe on the 8th; left on the 22d for a cruise in the Inland Sea, and returned on the 27th; left Kobe July 6, arrived at Nagasaki on the 8th, and same day departed for Swatow and reached there about the 30th, and remained, attending to wreckers of the Pacific Mail Steamship Company's steamer Japan, and left in the latter part of August for a cruise up the coast of China to Shanghai.

The Ashuelot, during the month of December, 1875, was at Shanghai, receiving new boilers, and remained there until March 22, when she sailed for Hong-Kong, arriving there on the 31st, and leaving on the 14th of April, went to Bangkok, Siam, and received on board the articles prepared for the United States Centennial Exhibition by the Siamese government, and returned to Hong-Kong June 10; left on the 19th for Swatow and other parts to the northward; arrived at Pagoda Anchorage, Foochow, China, July 2, from Amoy, thence to Ningpo and Shanghai, reaching the last named the latter part of the month, and leaving in September for Cheefoo.

The Yantic was at Nagasaki during the month of December, 1875, and remained until January 14, 1876, when she sailed for Shanghai, arriving on the 17th and remaining for repairs. On the 22d of March left for Amoy, Macao, and Hong-Kong; arrived at Macao April 2, (having stopped at Amoy from March 27 to 31,) and departed on the 9th, reaching Hong-Kong same day; left June 8, reached Nagasaki on the 19th, and arrived at Yokohama on the 23d, where she is repairing.

The Palos, during the month of December, 1875, was repairing at Shanghai, and remained until March 22, when she sailed for Hong-Kong and Canton, arriving at Hong-Kong the 28th and Canton April 30. Left Canton on the 7th of June, arriving same day at Hong-Kong; departed on the 8th, and reached Macao same day; returned to Hong-Kong on the 10th; sailed for Amoy; left and arrived at Pagoda Anchorage July 2, and at Shanghai on the 31st, and left on the 10th of August for Cheefoo, thence to Tientsin.

The Alert left New York May 26, for the Asiatic Station, via Suez Canal; touched at Gibraltar and Malta, passed through the canal July 23, touched at Aden and other ports, and arrived at Hong-Kong on the 11th of September, and thence sailed for Swatow and other ports south of Shanghai.

The Saco was at Yokohama during the month of December, 1875; on the 10th of January, 1876, arrived at Nagasaki, and after a short stay returned to Yokohama; on the 6th of May left and arrived at San Francisco on the 21st of June, and was put out of commission on the 13th of July.

## TRAINING-SHIPS, ETC.

The Juniata, formerly attached to the European station, left Gibraltar December 18, 1875, touched at Madeira, afforded relief to German brig Avance at sea, and reached St. Thomas January 15, 1876, sailing thence on the 18th, and arriving at Port Royal on the 25th; left on the 29th, touched at Norfolk February 4, departed the next day, and arrived at Baltimore on the 6th, and cruised as a training-ship for boys in the Navy, reaching Norfolk, Va., on the 31st of August, transferring her officers and men to the Monongahela, and was put out of commission September 6.

The Gettysburg returned to the navy-yard, Washington, June 14, 1876, having been engaged on telegraphic longitude work in the West Indies since the latter part of the year 1875, and was put out of commission on the 26th. On the 20th of September was put in commission at Washington, left for Norfolk on the 27th, and arrived the next day, and on the 17th October sailed on a surveying expedition, &c., for the Mediterranean.

The store-ship Supply left the New York navy-yard, January 7, 1876, to receive and bring to the United States for the Centennial Exhibition contributions from American artists residing in Europe, and also to bring the naval monument. Arrived at Civita Vecchia February 21, sailed March 2, and reached Leghorn on the 5th; left on the 20th for Gibraltar, arriving April 6, departing on the 8th, and reaching Philadelphia May 12, landed her goods, and June 9 went to Washington, arriving on the 16th, and landed the portion of the monument which she brought. On the 3d of July left for New York, arriving on the 8th, and sailing on the 17th as a training-ship for boys, and continued on that duty until September 30, when put out of commission at Boston.

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